The Electrical Industry's Weekly Magazine

October 15, 1956

Electrical World

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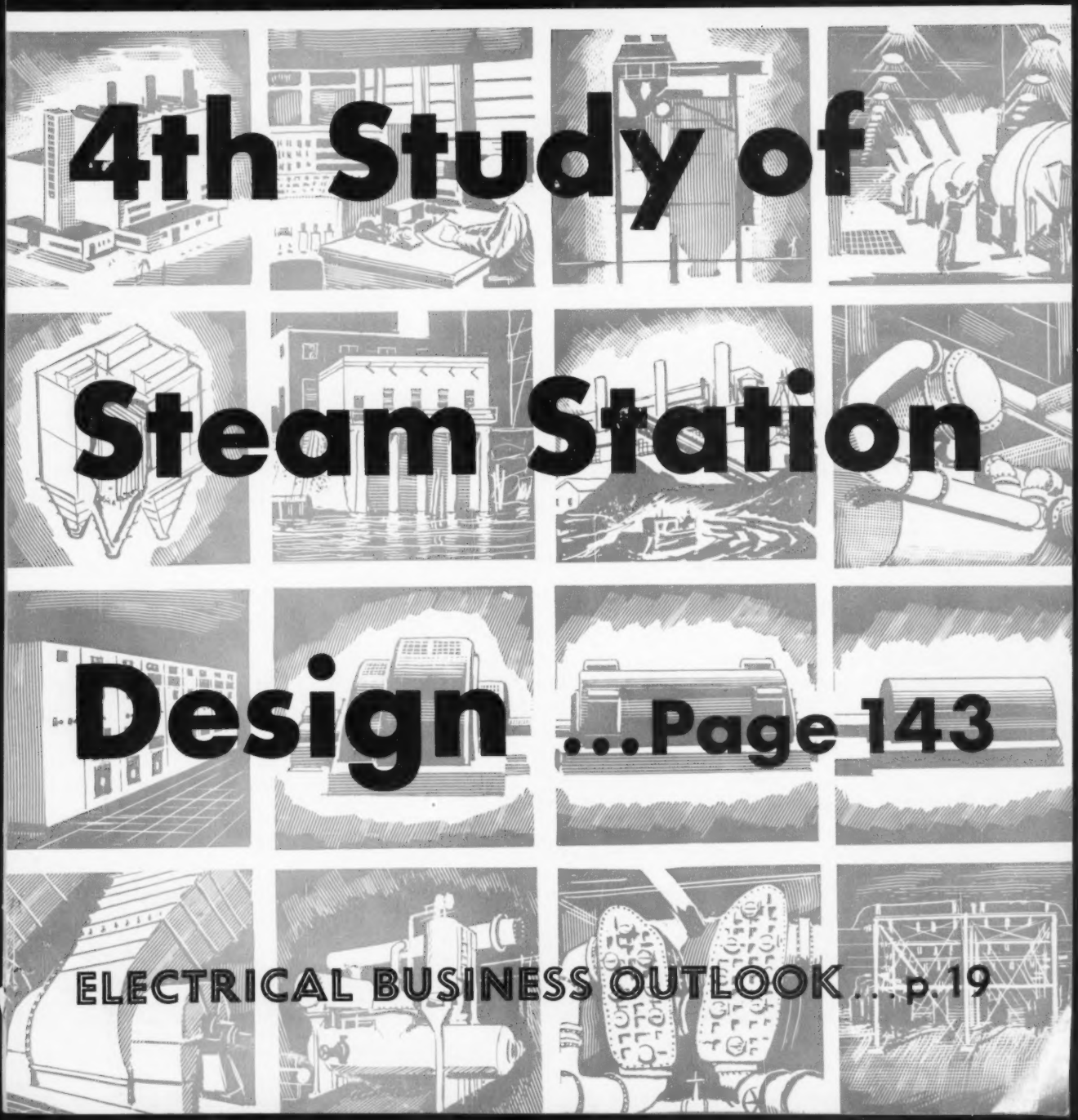

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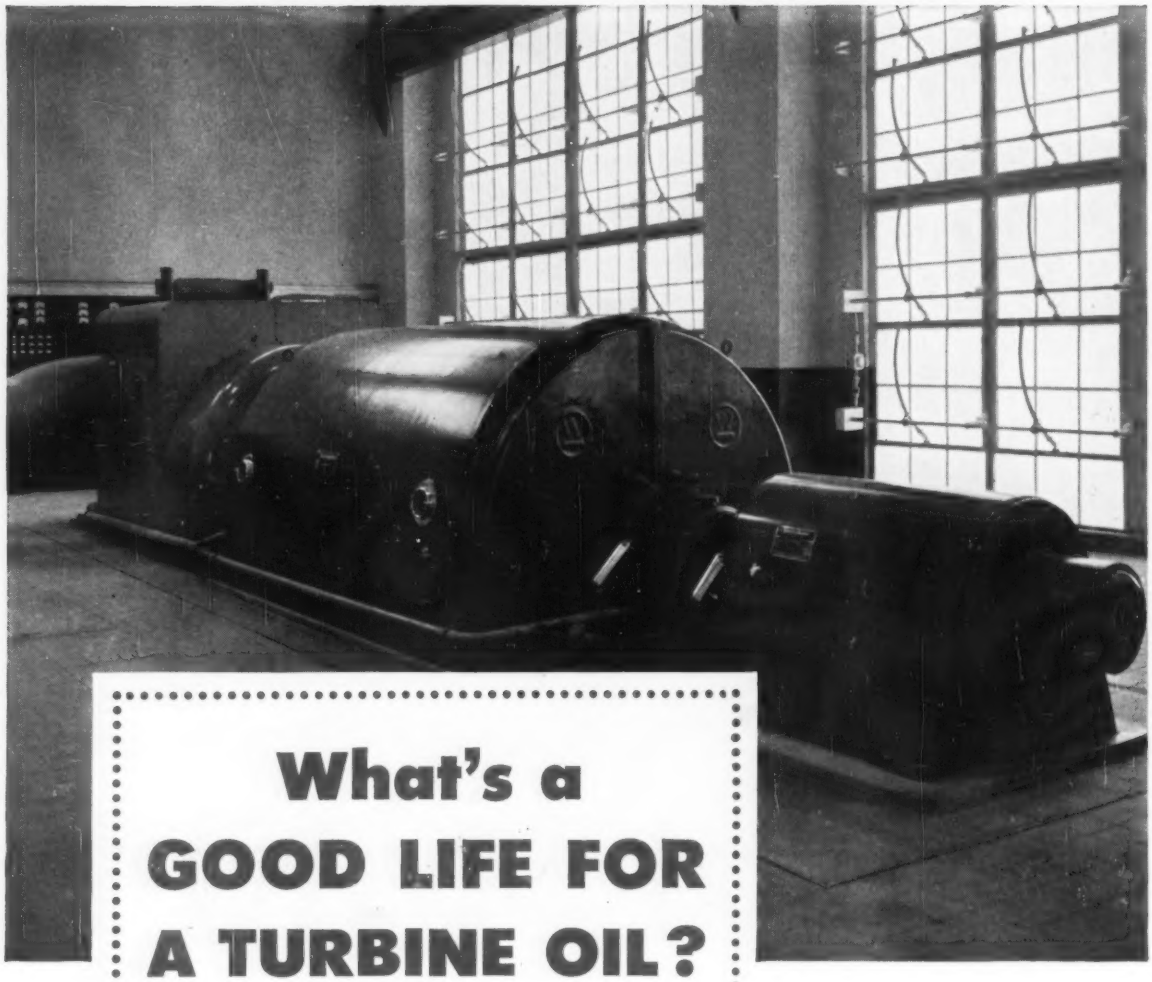

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Electrical World

Published for 82 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

Vol. 146, No. 16 **October 15, 1956**

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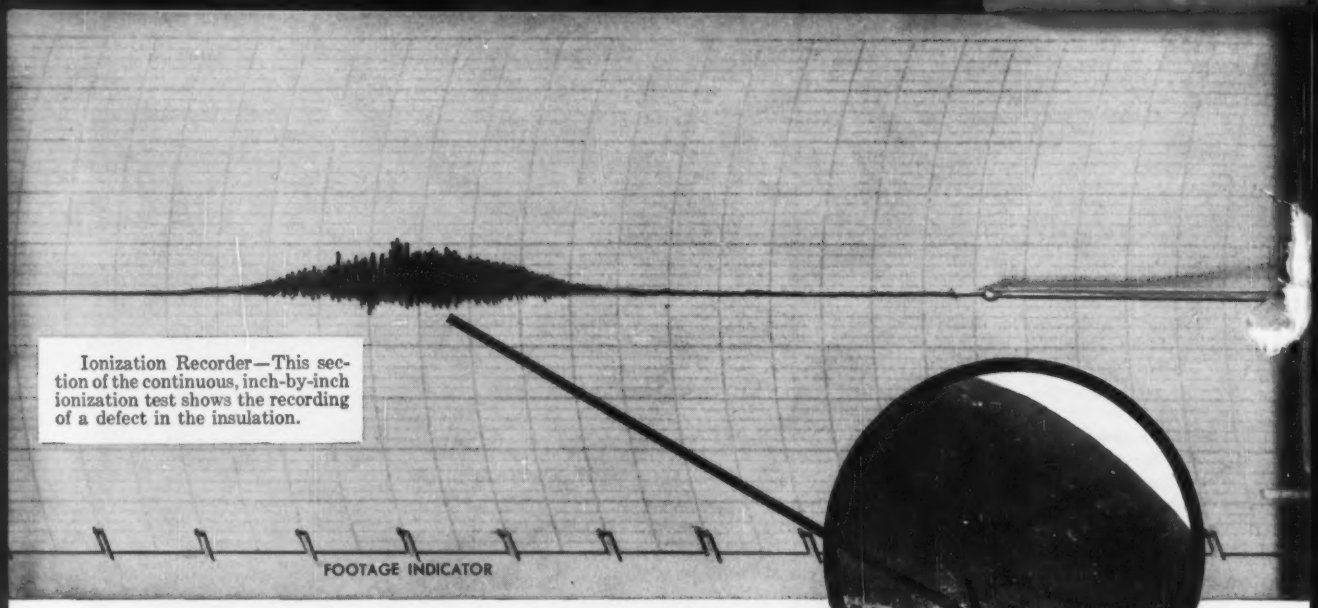


Ionization Recorder—This section of the continuous, inch-by-inch ionization test shows the recording of a defect in the insulation.

This void was detected by the "Gooding Test Train" ionization test. It was *not* detected by any of the industry's standard test procedures.

New Testing Procedure developed by Okonite

"Gooding Test Train" detects flaws in insulated power cable (2kv and over) heretofore unrevealed by standard tests

The "Gooding Test Train" has significant value to cable users. This new system of *non-destructive* testing, developed and used only by Okonite, reveals imperfections which are frequently not detected by ordinary testing procedures. Some of them even slip by Okonite's super-voltage a-c and d-c tests (highest used in the industry) and "full reel" corona tests.

The "Gooding Test Train" consists of a series of three test sets. The entire length of cable passes consecutively through each set as follows:

SCHEMATIC DRAWING OF GOODING TEST TRAIN

1. Uniformity Test—A uniformity gauge continuously checks insulation thickness—locating any thin spots which might cause premature failure.

2. Ionization Test—This is the most important unit of the "Gooding Test Train". It can measure the corona level at any spot along the cable. Procedure is to test the cable *inch-by-inch* at a predetermined voltage which is sufficient to assure the user that the corona level is at least 1½ times the rated voltage. Voids and imperfections as small as a grain of sand have thus been identified and removed.

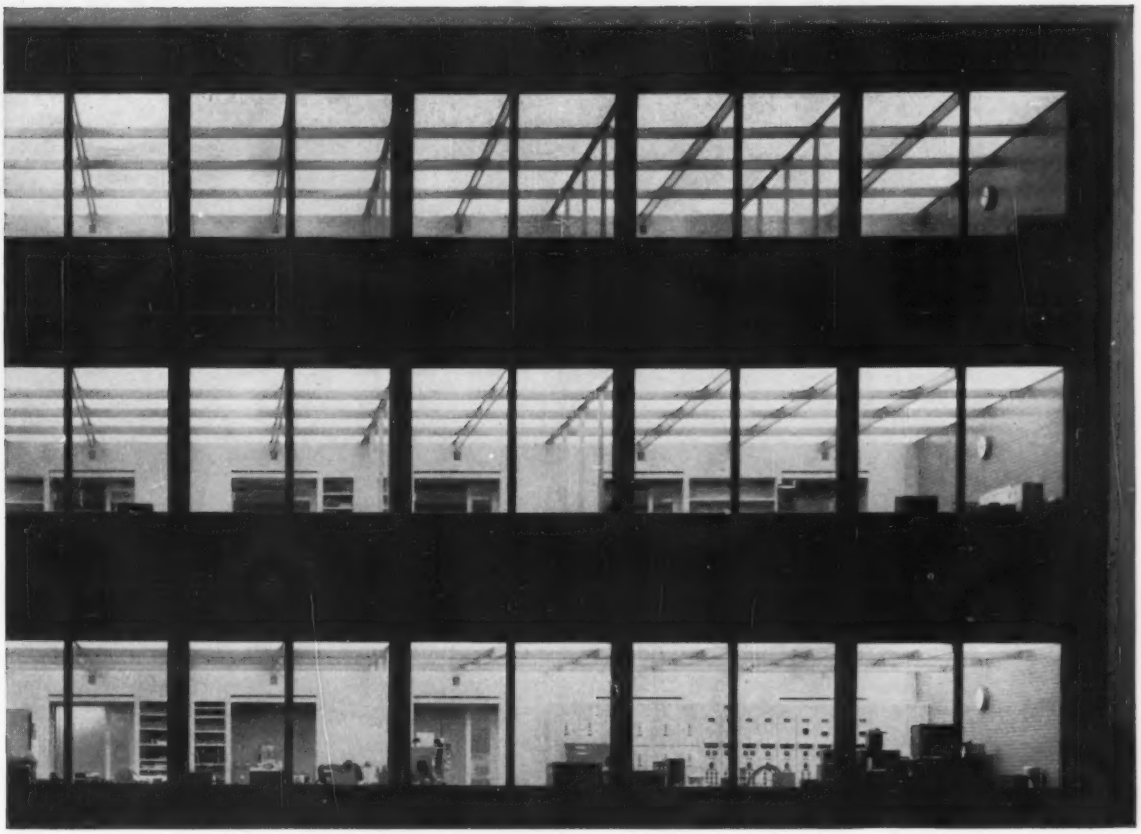
3. X-Ray Test—X-ray inspection of the cable is performed by a 250,000 volt X-ray machine. This determines the nature and extent of any of the flaws indicated above.

By such intensive testing, it is possible to eliminate previously unidentified imperfections that might otherwise lead to premature failure. Studies of such defects also help to identify the cause and permit preventive measures. The "Gooding Test Train" is now being used to test all Okonite's rubber-insulated cables rated at more than 2000 volts. It is a long step towards securing the "perfect cable" and, as such, of tremendous benefit to cable users.

For detailed information about Okonite's G.T.T. write for new Bulletin EW-1100, to The Okonite Company, Passaic, N. J.

where there's electrical power . . . there's **OKONITE CABLE**

3804-A



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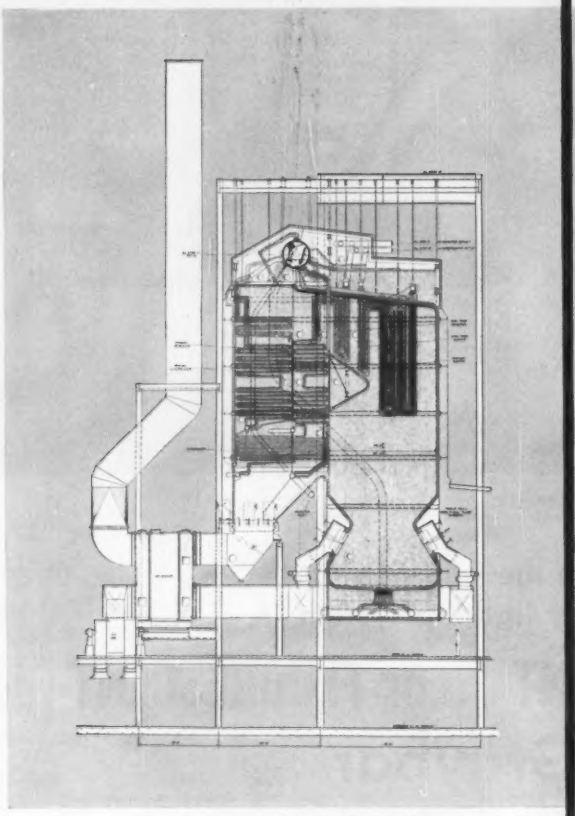
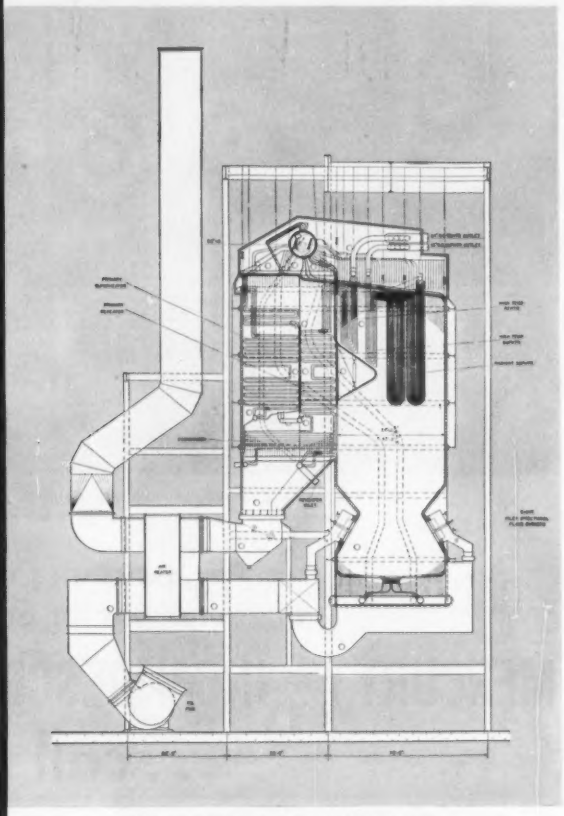


Riley Reheat TURBO FURNACE Unit:
For Texas Public Utility
Capacity: 825,000 lbs/hr. Pressure: 1750 psig design
Superheat and reheat temperatures: 1005 F
Fuels: Natural Gas, Oil, Future Coal
12 Riley Directional Flame Burners
Pressurized Turbo Furnace



Riley Reheat TURBO FURNACE Unit:
For Texas Public Utility
Capacity: 1,250,000 lbs/hr. Pressure: 2125 psig
Superheat and reheat temperatures: 1005 F
Fuels: Natural Gas, Oil and Future Lignite
16 Riley Directional Flame Burners
Pressurized Turbo Furnace

OTHER RILEY TURBO FURNACE UNITS INSTALLED OR ON ORDER

Northeast Paper Mill
One 175,000# Unit
Pulverized Coal

West Va. Chemicals Co.
One 289,000# Unit
Pulverized Coal

Eastern Seaboard
Public Utility
Three 500,000# Units
Fluid Coke

Southern Aluminum Co.
Two 320,000# Units
Gas, Oil, Future Coal

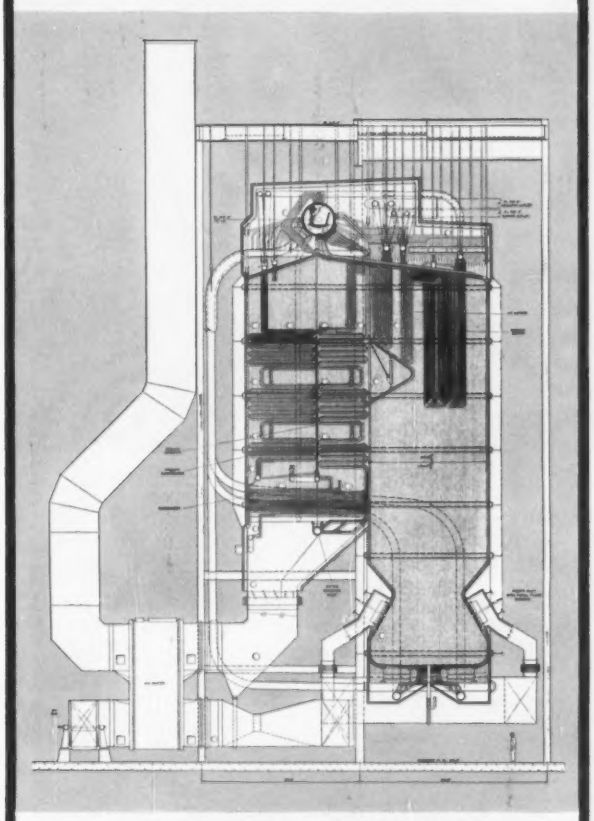
West Va. Chemicals Co.
One 175,000# Unit
Pulverized Coal

Phillipine Islands
Public Utility
One 430,000# Unit
Oil

RILEY DESIGNS, MANUFACTURES AND INSTALLS COMPLETE STEAM GENERATING UNITS AND FUEL BURNING EQUIPMENT FOR PUBLIC UTILITY AND INDUSTRIAL POWER AND HEATING PLANTS

public utilities are installing

FURNACE UNITS



Riley Reheat TURBO FURNACE Unit:
Louisiana Public Utility
Capacity: 1,550,000 lbs/hr. Pressure: 2125 psig design
Superheat and reheat temperatures: 1005 F
Fuels: Natural Gas, Future Oil, Pulverized Coal, Lignite, Delayed Coke, Fluid Coke.
20 Riley Directional Flame Burners
Pressurized Turbo Furnace

A survey of your plant by a consulting engineer could show ways of making surprising savings in your power costs.

BECAUSE . . . the TURBO FURNACE makes possible change-over from natural gas and oil to solid fuels firing with minimum of outage and minimum conversion cost . . . at the same time it provides a superior, efficient means of firing gas or oil.

When conversion to solid fuels becomes economically advisable the only major expense is the addition of pulverizers. Riley Directional Flame Burners are already equipped with coal heads for easy, quick hook-up to pulverizers.

USES A WIDE RANGE OF FUELS

The method of firing and the high heat and high turbulence in the combustion zone makes possible the efficient and economical use of any fuel that is burned in suspension: gas, oil, all grades of coal, lignite, delayed cokes and fluid coke.

OFFERS MANY ADDED ECONOMIES

- Flyash disposal is eliminated by reinjecting flyash and converting it to slag.
- Minimum carbon loss, higher efficiency.
- Clean furnace — no soot or slag blowing is needed; a large percentage of ash is retained in combustion zone and furnace exit gas temperatures are exceptionally low.
- More uniformity of furnace temperature across superheater and reheater.
- Method of firing makes possible less overall height.
- One level burner operation.

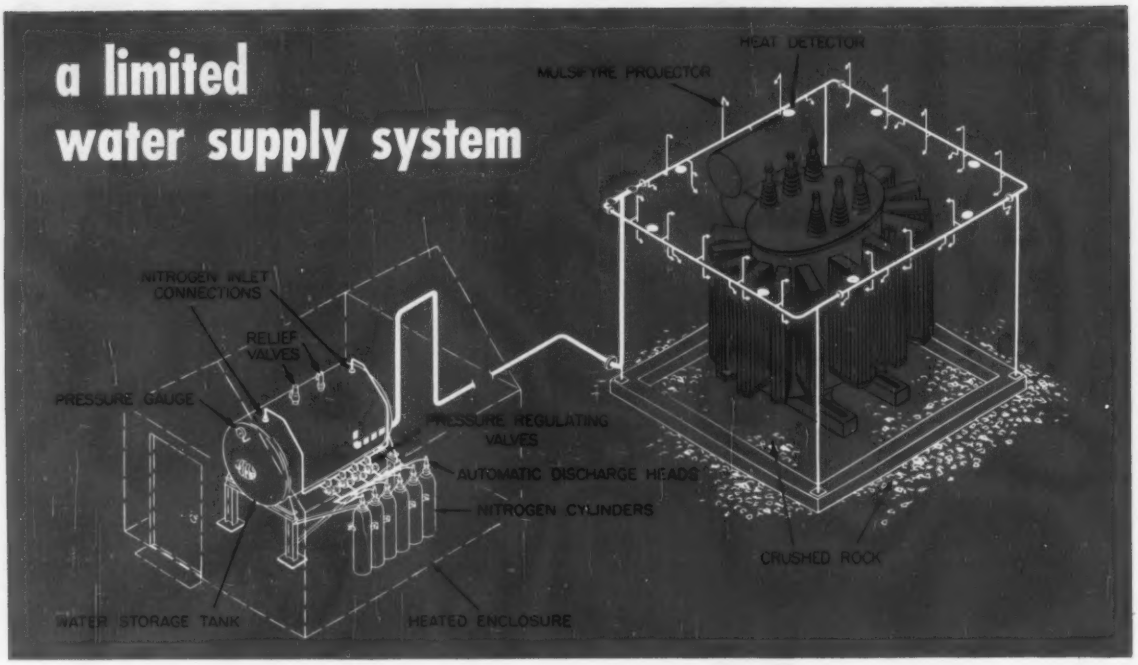
REMOTE AND ELECTRONICALLY CONTROLLED FIRING

Complete automatic and remote firing controls with electronic safeguards are available for Riley Directional Flame Burners.

RILEY
Stoker Corporation
WORCESTER, MASSACHUSETTS

Sales Offices: Worcester, New York, Philadelphia, Buffalo, Pittsburgh, Cleveland, Detroit, Chicago, Cincinnati, Charlotte, New Orleans, Atlanta, St. Louis, Kansas City, St. Paul, Houston, Denver (Englewood), Salt Lake City, Los Angeles, San Francisco, Portland, Seattle.

NOW!
Grinnell SELF-CONTAINED Mulsifyre Protection

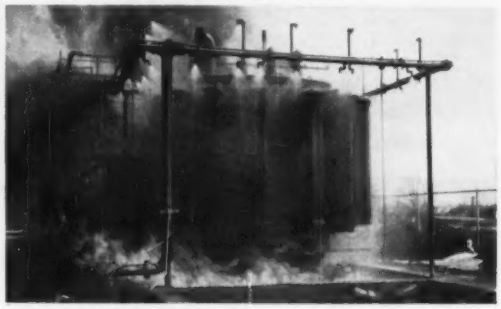


You need no longer be without water spray protection simply because your hazard is distant from city water mains. Grinnell's new *Self-Contained* Mulsifyre System provides automatic detection and prompt water spray protection in extinguishing fires while still small, and in preventing their spread with possibly serious damage.

Water spray protection, of course, presupposes water under pressure. Grinnell's *Self-Contained* System successfully achieves this through the use of nitrogen gas, stored in cylinders under high pressure, which drives the water from the storage tank at spray-forming velocities. As with all Grinnell Fire Protection Systems, the component parts of the Self-Contained Mulsifyre System are fully listed by Underwriters' Laboratories and meet specifications covered in NBFU Standards 13 and 15.

Your particular hazard will be thoroughly analyzed by the Grinnell Fire Protection Division, which introduced water spray protection in America — and has the widest possible background experience in its use. Full consideration will be given to the property to be protected, as well as to all other adjacent exposure hazards.

Let a Grinnell Fire Protection Engineer tell you more about this system. Grinnell Company, Inc., 252 West Exchange Street, Providence, Rhode Island. Branch offices in principal cities.



Grinnell *Self-Contained* Mulsifyre System successfully operating to extinguish fire under test conditions

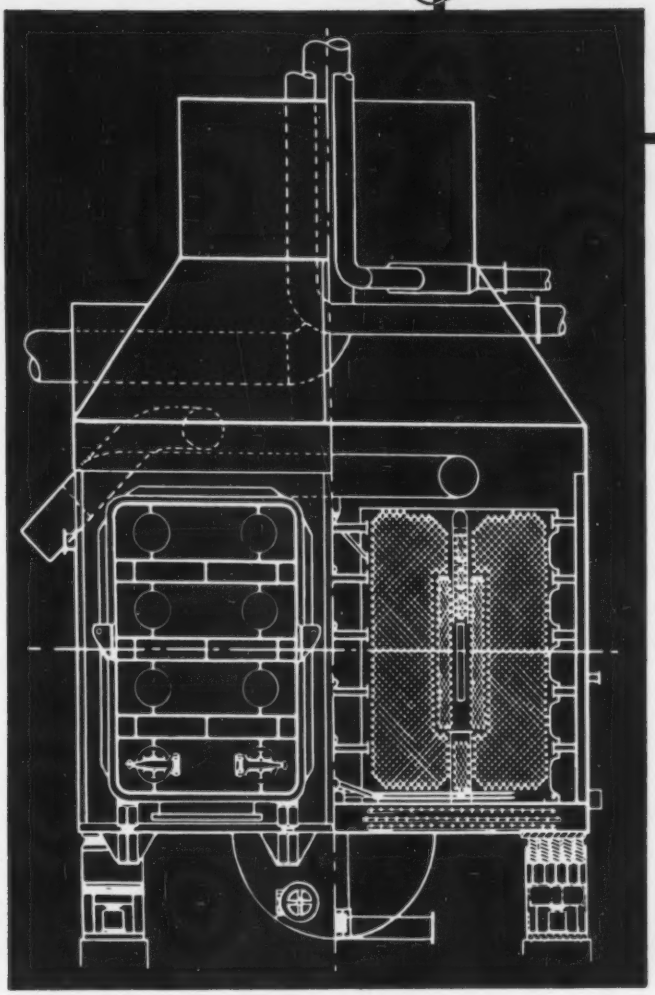
GRINNELL *Mulsifyre*

EMULSION EXTINGUISHMENT OF OIL FIRES

DUAL BANK Condensers

by C. H. Wheeler

For Your Electric Generating Plants of Tomorrow



- Specifically designed for larger, more efficient electric generating stations.
- Adaptable to your station layout.
- Designed to minimize field erection problems.
- Additional steam lanes shorten path and resistance to steam travel.
- Lower pressure drop and higher vacuum.
- "Zero" condensate temperature depression.
- DEAERATION . . . 0.01 cc per liter is attainable.
- Purity of condensate.

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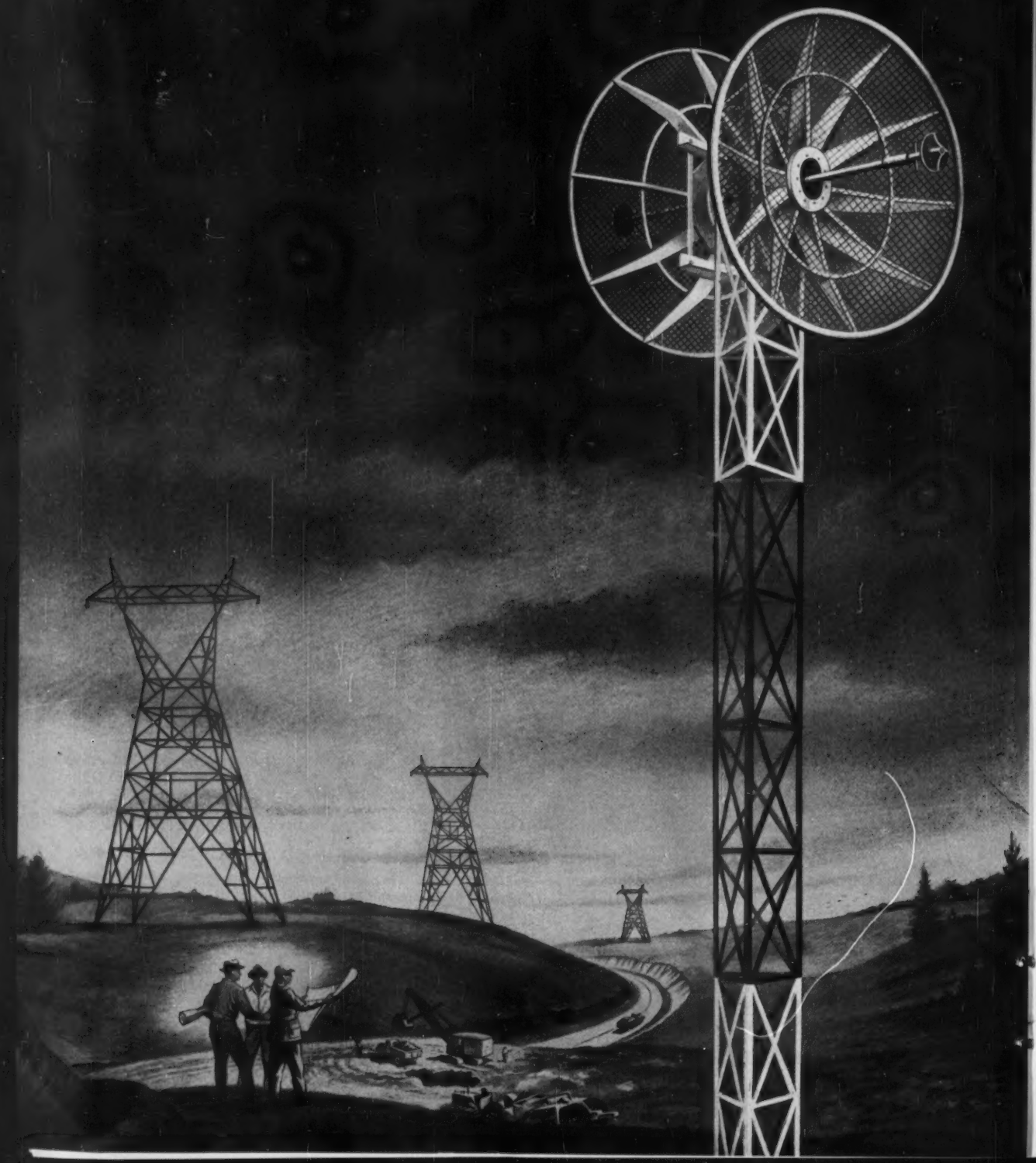

Microwave
KEEPS UTILITIES ON THE BEAM

In a tremendous surge of expansion, electric utilities are putting up new installations essential to the national economy, right across the nation.

RCA Microwave is providing these utilities with dependable communications systems, easily expandable, capable of handling every vital communication function including voice, teletype, telemetering, supervisory control, load control, relaying and transfer trip, facsimile, remote control, operation of mobile radio and others.

Through the use of microwave, voice or data intelligence reaches every part of the territory served and the whole system can be under the dispatcher's immediate control.

All this is accomplished with speed, efficiency, reliability and economy compatible with and, in most cases, superior to that provided by any other means—without high maintenance costs, expensive right-of-way problems, or vulnerability to weather vagaries.

ON PIPELINES—In the petroleum and natural gas industries where pipelines knife across the country, RCA Microwave systems link dispatching and control points with pumping stations and unattended remotely operated booster stations. Pipeline capacity is increased and operating costs are cut. VHF control channels allow immediate contact with maintenance personnel.

ON TURNPIKES—On the new cross-country superhighways RCA Microwave provides circuits for voice, facsimile, teletype, VHF control, traffic information and business machine communications . . . gives operating personnel complete control of the road, greater safety and service to driver patrons around the clock, in fair weather or foul.

RCA MICROWAVE provides the most advanced engineering features. Provision for the easy addition of future channels makes it the least expensive form of communication per channel mile. Equipment uses easy-to-service, familiar circuits and readily available tubes. Single sideband suppressed-carrier frequency division multiplex is used exclusively to meet high standards of dependability and quality of transmission. Frequency control for the system is concentrated at the terminal stations. And only *two* frequencies are usually required. Furthermore, RCA provides the nation-wide service of the RCA Service Company to keep your system operating at its peak.

RCA Microwave Representatives, with years of microwave experience, will be glad to answer any questions and to assist in planning your installation. Mail coupon for further particulars.

RCA MICROWAVE is easily interconnected with mobile radio installations as well as existing telephone lines and switchboards. Field maintenance crews, no matter how remotely located, can be contacted from any station or office. Instant communication in the field means hours per day saved in parking, backtracking and preventing costly delays.

PERFORMANCE PROVED IN MORE THAN A MILLION CHANNEL MILES OF OPERATING SYSTEMS THROUGHOUT THE WORLD

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RCA

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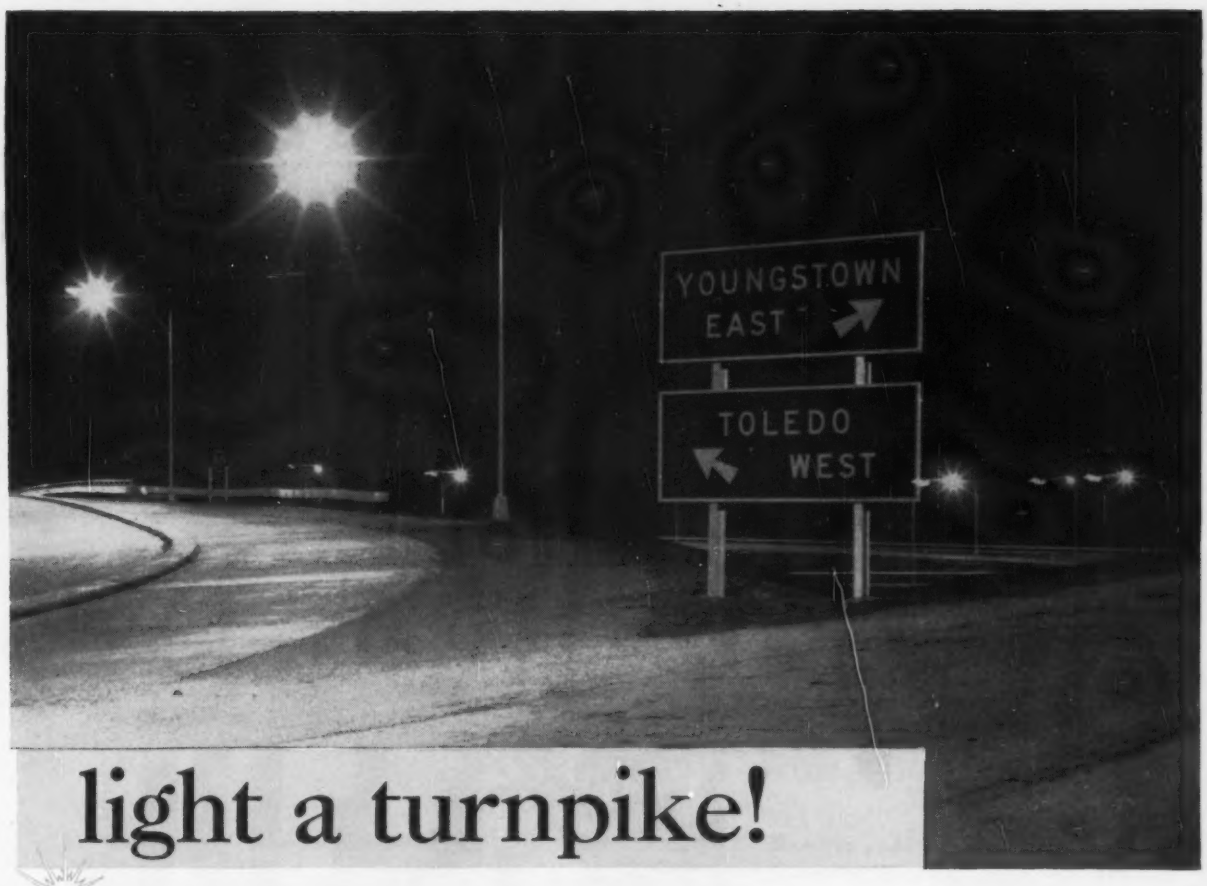
Company _____

Address _____

City _____ Zone _____ State _____

☐ Have RCA representative get in touch with me.

HERE'S the way to



light a turnpike!

The new Ohio Turnpike, spanning the state from Pennsylvania to Indiana, is a model of modern highway construction. And one of the outstanding features of this road is the lighting of the interchanges.

What an immense job it was to build this 241-mile road! Enough dirt was excavated to fill a two-lane tunnel 268 miles long. They dumped enough fill to cover 500 football fields to a depth of 28 feet. Carefully the bogs were drained, slides were stopped and the rock was blasted to make the great road possible.

Skillful engineering is apparent along every foot of the Turnpike—and this includes the selection of vital materials used to build it. Buried in the ground near the interchanges you'll find over half a million feet of Tiger Brand 3,000-volt internal shielded cable serving as main feeders. Many thousands of feet of Tiger Brand RR cable serve as bracket cable in the poles, and an additional quarter million feet of Tiger Brand cable grounds the entire system.

When you install Tiger Brand cable, you have gone a long way toward insuring a trouble-free wiring system.

AMERICAN STEEL & WIRE DIVISION, UNITED STATES STEEL, GENERAL OFFICES: CLEVELAND, OHIO
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS • TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA., SOUTHERN DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

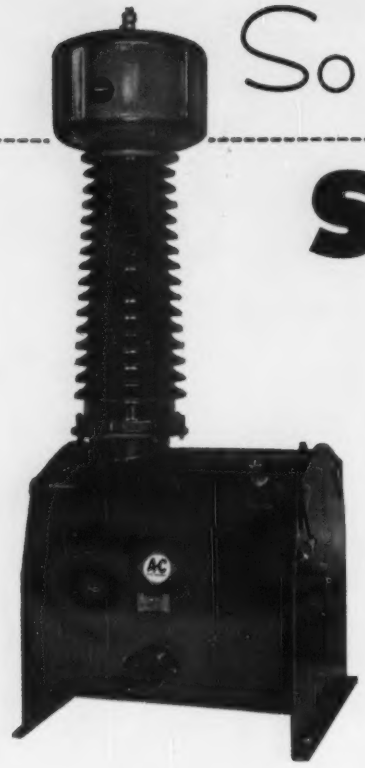
USS TIGER BRAND ELECTRICAL WIRE & CABLE

A STANDARD TIGER BRAND CABLE FOR EVERY SPECIAL JOB

- machine tool and building wire
- special purpose wire and cable
- asbestos wire and cable
- paper and varnished cambric cable
- aerial, underground and submarine cable
- shovel and dredge cable
- mold cured portable cord

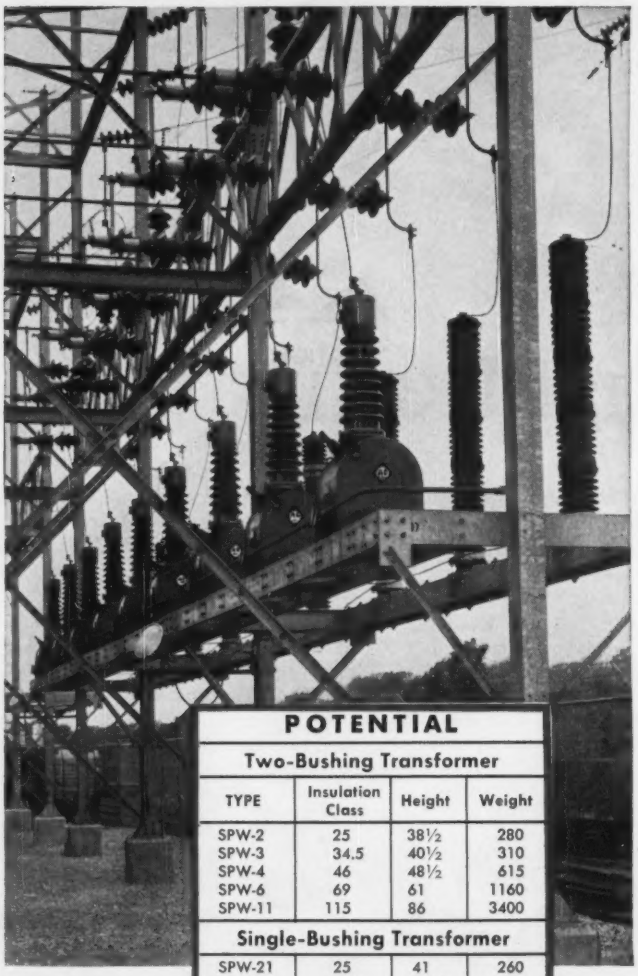
USS

UNITED STATES STEEL



So Light...SO COMPACT

So *Easy* to Install



MUCH smaller and lighter than previous designs, new Allis-Chalmers potential transformers cut installation costs and provide maximum handling convenience. Less space and less foundation to mounting structure are required. A fork truck or block and tackle is all that is needed to lift these 69-kv units into position. And, of course, relocating is accomplished just as easily.

Performance has also been improved in both ratio and phase angle with the advanced design of Allis-Chalmers potential transformers.

Many other design features — features that assure unparalleled dependability and long life — have been incorporated in these modern units. Get the complete story from your local A-C representative or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wis.

POTENTIAL

TYPE	Insulation Class	Height	Weight
Two-Bushing Transformer			
SPW-2	25	38½	280
SPW-3	34.5	40½	310
SPW-4	46	48½	615
SPW-6	69	61	1160
SPW-11	115	86	3400
Single-Bushing Transformer			
SPW-21	25	41	260
SPW-31	34.5	44¼	285
SPW-41	46	50¾	460
SPW-61	69	63¾	950
SPW-111	115	92	2310
SPW-131	138	112	3510

New Ratings have been added to the Allis-Chalmers line of potential transformers to include higher voltage insulation classes.

A-C ALLIS-CHALMERS

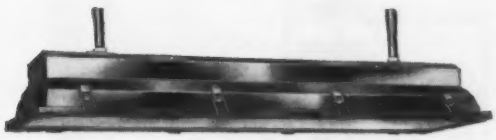
ALLIS-CHALMERS

A-5164

HOWEVER YOU MEASURE YOUR LIGHTING REQUIREMENTS

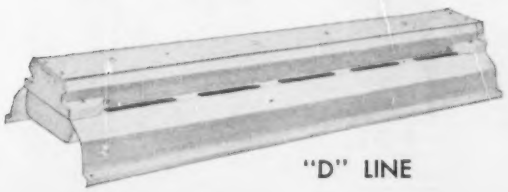
there's a *Wheeler* fixture for every job

In industry after industry, on job after job, Wheeler's wide range of fixtures and features insures peak efficiency for practically every lighting requirement. Shown here: three outstanding examples of Wheeler's tremendous line of industrial lighting fixtures.



DUST-TIGHT · VAPOR-TIGHT

BI-FLO UPLITER



"D" LINE

There's a Wheeler Incandescent or Fluorescent Lighting Fixture to meet every industrial requirement.

Wheeler Reflector Company

275 Congress Street - Boston, Mass.

Distributed Exclusively through Electrical Wholesalers

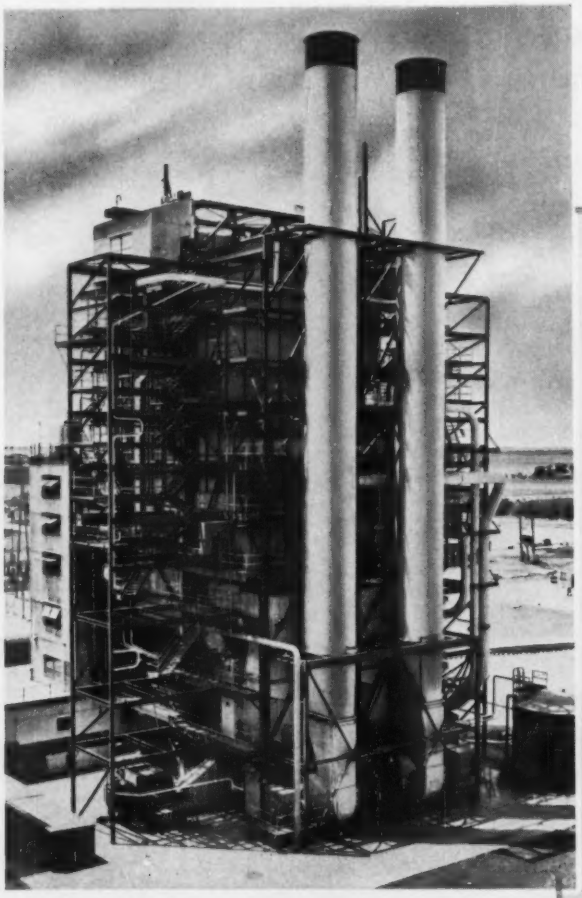
Certified Lighting for a Better America

75th Anniversary *1881-1956*

Kansas Gas and Electric puts third*

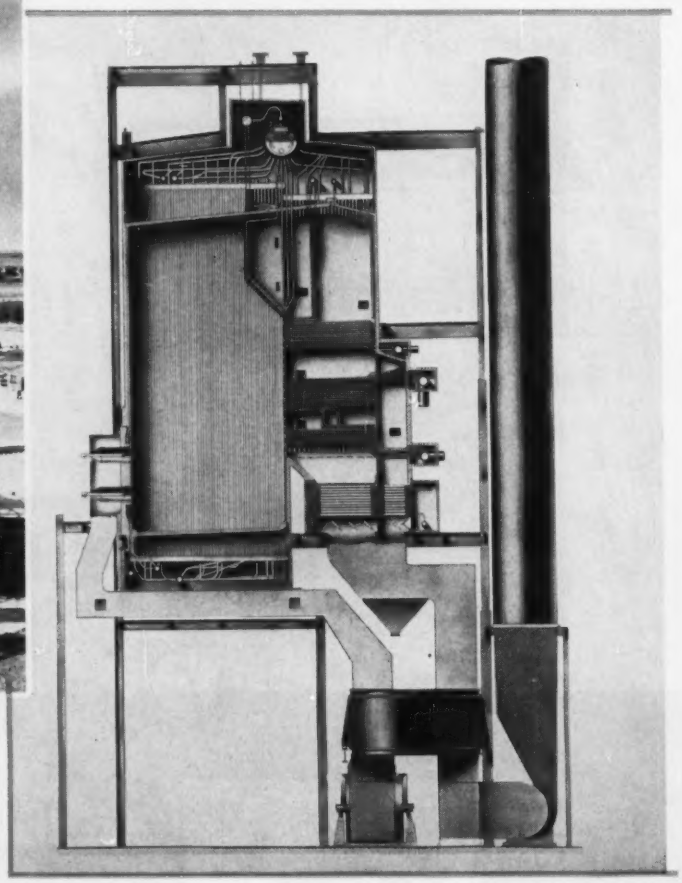
FW steam generator "on the line" to help . . .

MEET GROWING DEMAND



Foster Wheeler steam generator, unit no. 3, at the Murray Gill Station of the Kansas Gas and Electric Co. just southwest of Wichita, Kansas. A Foster Wheeler 65,000 sq ft surface condenser of the double-flow type serves the 115,000 kw turbine.

*A fourth FW steam generator, of 800,000 lb per hr capacity is now on order for the Murray Gill Station.



Cross-section of the reheat unit shows arrangement of furnace with space provided for possible future conversion to coal firing.

FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

ON MURRAY GILL STATION

Of outdoor design, this 800,000 lb per hr Foster Wheeler reheat steam generator supplements two other FW units of 425,000 and 625,000 lb per hr capacity serving this modern central station.

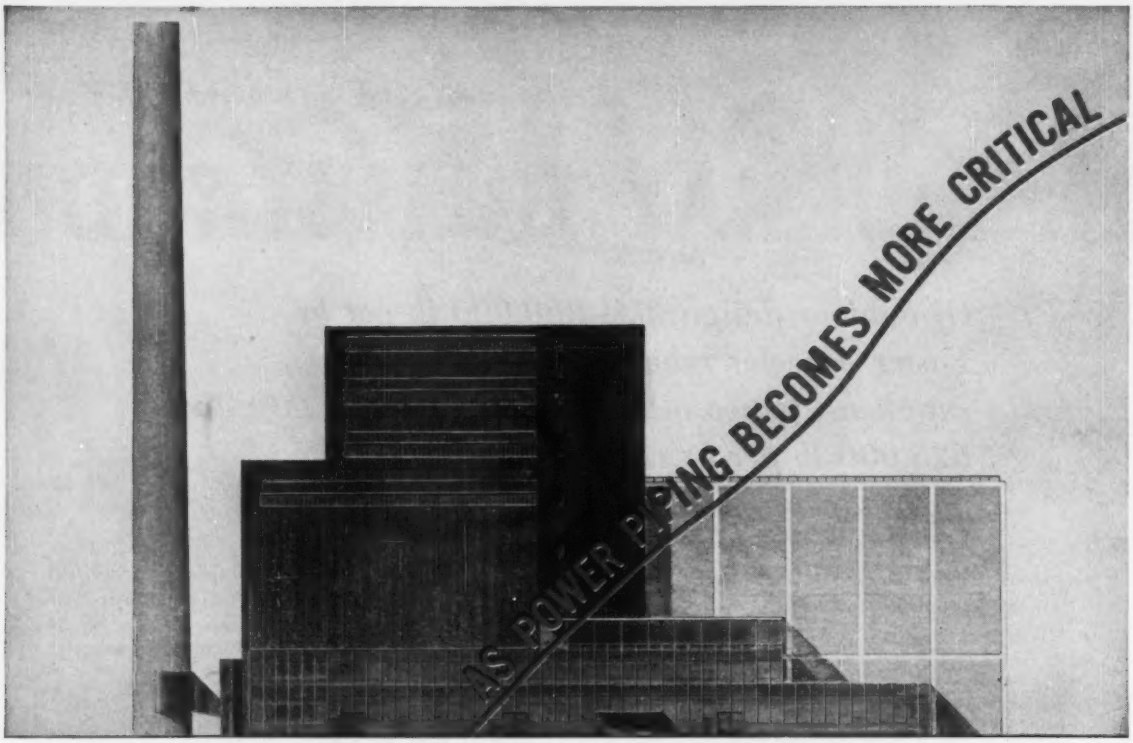
CUSTOMERS of Kansas Gas and Electric Company are consuming more and more electric power. The greater use of electric appliances in the home, increased commercial business, enlarged industrial production — all are resulting in an ever-growing demand on the company's facilities.

And at the Murray Gill Station, the company's newest and most efficient operation, with a total generating capability of 240,000 kw, three Foster Wheeler steam generators are now helping meet this upward trend.

The third FW unit to be installed at Murray Gill went into service in April of 1956 — 20 months after placing of contract. It has a capacity of 800,000 lb steam per hr with corresponding reheater flow of 692,000 lb per hr and steam outlet conditions of 1005 F/1005 F and 1925 psig at the superheater outlet.

Repeat orders like this represent a positive expression of confidence in Foster Wheeler steam plant equipment. With more than fifty years of experience in steam generation — and the finest modern manufacturing facilities in three large plants — Foster Wheeler welcomes the opportunity to quote on your requirements. *Foster Wheeler Corporation, 165 Broadway, New York 6, N.Y.*

Aerial view of Murray Gill Station of KG&E, showing outdoor-type reheat steam generator at left and FW dual circulation units at right.



Architect's sketch of Philadelphia Electric Company's new Eddystone station

Kellogg's High Alloy Fabrication Keeps Pace

Designed to operate at 5000 psi at turbine throttle valve, and 1200 F., Unit No. 1 at Philadelphia Electric Company's new Eddystone station presented critical problems in the selection of an alloy for supercritical pressure piping, and in techniques for fabricating heavy-walled sections of this alloy in the shop and in the field.

More than a year ago, The M. W. Kellogg Company presented a comprehensive program to the Philadelphia Electric Company for selecting a suitable alloy, and since then has been working closely with this public utility and other prime contractors toward completion of the project. Numerous materials were studied, welded, tested, heat treated, and evaluated at Kellogg's Jersey City metallurgical laboratories. After many months of extensive and intensive work, Type 316 Stainless was selected. M. W. Kellogg has already perfected welding techniques, and is now continuing tests on this alloy and several other compositions, including strain aging for 1000 hours and 10,000 hours at 1300 F., to accumulate other data.

While this is the first time that Type 316 will have been used in power plant service for temperatures as high as 1200 F., and pressures as much as 5000 psi, it is by no means Kellogg's first experience with Type 316 or other stainless steels. For example, M. W. Kellogg recently undertook metallurgical studies and research for another large public utility prior to its selection of Type 316 for use at 1100 F. and 2400 psi. Kellogg also has done considerable fabrication of main steam lines and turbine leads, using Type 347.

The M. W. Kellogg Company welcomes the opportunity of discussing future power piping requirements with consulting engineers, engineers of power generating companies, and manufacturers of boilers, turbines, and allied equipment.

FABRICATED PRODUCTS DIVISION
THE M. W. KELLOGG COMPANY, 711 THIRD AVENUE, NEW YORK 17, N. Y.
A SUBSIDIARY OF PULLMAN INCORPORATED
The Canadian Kellogg Company Ltd., Toronto • Kellogg International Corp., London • Kellogg Pan American Corp., New York • Societe Kellogg, Paris • Companhia Kellogg Brasileira, Rio de Janeiro • Compania Kellogg de Venezuela, Caracas

POWER PIPING—THE VITAL LINK

ELECTRICAL BUSINESS OUTLOOK

Electrical World
OCTOBER 15, 1956

Soft coal prices are on the way up again. The United Mine Workers new one-year wage contract assures just that. Last year when miners settled for a similar wage boost ($1.20 Oct. 1 and 80¢ next April) soft coal prices advanced 25 to 40 cents a ton. This year's increases will probably be in the neighborhood of 30 to 45 cents a ton. Bigger price boosts can be chalked up to much larger demand for soft coal this year.

Higher coal prices will jump utility fuel costs from $450,000 to $650,000 next year when around 360 billion kwhr will be generated in coal burning stations. And that's figuring on a further drop in the coal rate to around 0.93 lb. per kwhr from last year's 0.96 lb. per kwhr.

Even at higher prices, getting coal may become a problem in coming months. Railroads are already talking of shortages in gondola and hopper cars. They attribute this to a 9% increase in soft coal output and a 57% increase in exports. With production and exports expected to go higher you can expect the shortage to get worse.

• • •

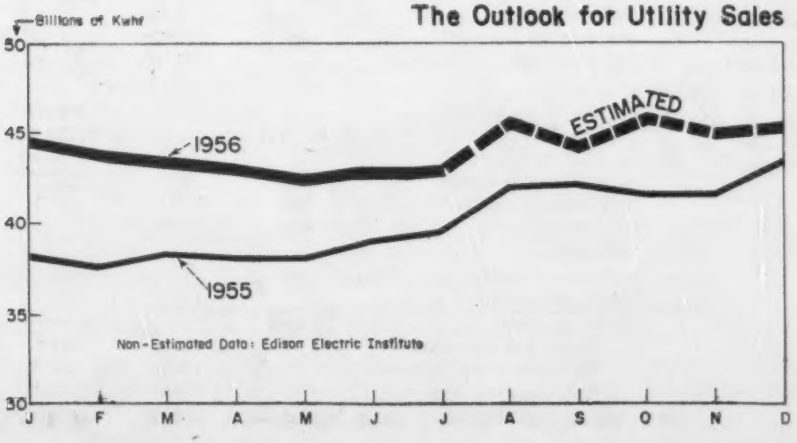
Copper will be in more than ample supply in this quarter and well into 1957. This turnabout from last year's situation stems from increased production in the face of decreasing demand. New automobile models had been expected to perk up brass mill shipments in this quarter. But so far orders from the auto industry have been disappointing. It now appears that autos may not consume as much copper as they used to. It's reported that one big car maker is using stainless steel in place of copper radiators.

• • •

Price increases on new automobiles are another factor that will push operating expenses higher next year. One manufacturer reports average price increases of only 2.9% on 1957 models. But you have to dig deeper to see what the boosts mean to fleet owners. Actual dollar increases on this manufacturers fleet-type vehicles range from $85.00 to $105.00. This is an increase of 5 to 6% over last year's prices. This means . . .

Electric utilities will pay about $75,000 more next year for passenger cars. That's figuring utilities will buy around 7,700 passenger cars for replacement and expansion.

The Outlook for Utility Sales



STATISTICS

Power Consumption at Major Atomic Energy Commission Installations

Calendar Year	Total Cost (Dollars)	Purchased Energy: Mills per Kwhr	Purchased Energy: Kwhr (Thousands)	Net Generation: Own Use Kwhr (Thousands)	Total Use Kwhr (Thousands)
1943	161,483	5.23	30,863	.....	30,863
1944	2,886,273	3.82	755,240	408,445	1,163,685
1945	6,904,299	3.41	2,027,119	1,071,533	3,098,652
1946	7,183,627	3.22	2,229,057	1,319,134	3,548,191
1947	6,255,193	3.24	1,930,419	1,302,094	3,232,513
1948	7,111,239	3.37	2,108,194	1,369,043	3,477,237
1949	7,807,596	3.35	2,328,674	1,285,041	3,613,715
1950	7,431,677	3.28	2,267,399	1,526,812	3,794,211
1951	17,160,117	4.48	3,827,266	1,705,251	5,532,517
1952	30,103,848	4.44	6,778,280	1,694,532	8,472,812
1953	59,000,183	4.68	12,606,718	2,120,120	14,726,838
1954	115,517,735	4.85	23,822,217	2,736,557	26,558,774
1955	207,412,541	4.40	47,132,862	2,800,953	49,933,815
1956*	113,715,044	3.97	28,673,356	1,397,811	30,071,167

*Preliminary First 6 Months

Source: Reports of the Atomic Energy Commission 1943 through 1952. Reports of utilities and operators to the Federal Power Commission 1952 to Date.

Power Statistics . . .

		Latest Month	Preceding Month	Year Ago	Annual Change %
Capacity, Peak—Class 1 Systems, Estimated Dec. '56 Peak	million kw, July	117.54	117.50	108.79	8.0
	July	94.8	97.0	89.3	6.2
	July	106.09	106.06	103.47	2.5
Production—billion kwhr	July	49.45	49.45	46.63	6.0
Hydro		9.91	10.05	9.35	6.0
Fuel		39.54	39.40	37.40	5.7
Sales—billion kwhr	July	44.57	44.53	40.89	9.0
Residential		11.38	10.98	9.92	14.7
Commercial		7.74	7.28	6.91	12.0
Industrial		22.71	23.80	21.49	5.7
Other		2.73	2.48	2.57	6.2
Fuel Consumption	July				
Coal—million tons		12.00	12.34	11.74	2.2
Oil—million barrels		4.32	4.61	4.63	−6.7
Gas—billion cu. ft		136.97	127.04	127.62	7.3
Net Income Class A & B Co's—$ million	July	96.86	102.20	89.40	8.3
Residential Customers—millions	12 mos.	45.10	44.99	43.84	2.9
Revenue per kwhr	ended	2.61¢	2.62¢	2.66¢	−1.9
Avg kwhr per customer	July 31	2,899	2,879	2,662	8.9
Avg annual bill		$75.66	$75.43	$70.81	6.8

Business Statistics . . .

Indexes: 1947–49 = 100					
FRB Industrial Production	Aug.	141	128	139	1.4
ENR Construction Cost	Oct.	147.6	147.8	141.3	4.5
BLS Cost-of-living	Aug.	116.8	117.0	114.5	2.0
NEMA Sales					
Insulation materials	July	117	156	117	0
Electric appliances		111	106	98	13.3
Wholesale prices	July				
Motors and generators		133.1	132.3	121.5	9.5
Transformers and regulators		134.5	138.2	127.3	5.7
Switchgear and fuses		152.6	152.3	135.5	12.6
GNP—annual rate—$ billion	2nd Qtr.	408.3	403.4	387.4	5.4

Your Business

Load builders of the future. Five years ago David Sarnoff, board chairman of the Radio Corp of America, ordered his scientists to deliver some pretty special devices to celebrate his fiftieth anniversary in the electronics industry. The scientists came through a few weeks ago. The devices: an all-electronic air conditioning system with no moving parts, a refrigerator based on the same principle, a magnetic tape that will reproduce a picture and sound, and a light amplifier that increases the brightness of a projected image by as much as 1,000 times. All, in time, may find household use. Instead of a phonograph record library, we may start collecting a TV tape library. It may be we can save some of those dark, dark photo negatives with that light amplifier.

Political note. Linemen of Pennsylvania Power and Light Co are asking political candidates to keep their posters off power poles in their area. Tacks and staples used to hold the posters are a hazard to linemen who must climb the poles.

Electrified pogonotomy. That means electric shaving and some 20 million men rely on their electric razors daily to trim down some 30,000 whiskers each. Added up, electric power is whisking away some 600 billion whiskers a day. For these statistics, we're indebted to Remington Rand, which has just put out a new type electric shaver. Sal (the Barber) Maglie, ace pitcher of the Brooklyn Dodgers, was guest of honor at the ceremonies announcing the new razor. And press relations men dug deeply for beard-cutting background. Samples:

Earliest razors were of flint and date from about 6,000 B. C.

If it were possible to confine beard growth to one single whisker it would grow fifty feet per day.

"Please, dear, can't you get mad about this undeveloped 1.1 million kw power potential after our honeymoon is over?"

Your Health—Sick Headaches

REX H. WILSON, MD, Medical Director, B. F. Goodrich Co

Many persons suffer from "sick headache" or migraine. There is usually a severe pain which begins over one eye or in the back of the neck and extends over the entire side of the head. It may move from side to side. Nausea and vomiting frequently accompany it.

This type of headache usually occurs at regular intervals. Women frequently have it at their menstrual times. It is interesting to note that several members of the same family may have migraine headaches. Most attacks of migraine are preceded by visual disturbances such as spots before the eyes and a blurring of vision. The patient may feel dizzy. He may have pain in his abdomen. He may have tender areas about the face and scalp. The attacks can last for an hour or several days. They may be mild, or they may be so severe that the patient is eventually forced to go to bed in a darkened room.

The cause of migraine headaches is not certain. It is probably due to dilation of the blood vessels about the brain. Allergies or glandular abnormalities may be factors.

Most patients suffering from migraine experienced their first attack in their teens and continued having them through the years.

Treatment of migraine headaches varies. Many patients find relief when they lie down and relax for an hour or so. Physicians have found the ergotamine preparations and oxygen of benefit in many of the more severe cases. Correction of allergies and glandular disorders has helped others.

A "sick headache" can cause a person to be both miserable and useless. Your best chance for controlling this disabling affliction is to consult with your physician. And you need not wait for the next attack to do this.

WASHINGTON COMMENT

Rural Co-ops Lose Crusade Appeal

V. CRAIG RICHTER, Washington Correspondent

That the rural electric co-op has matured and is entering a new phase of development is evident from the recent series of talks by Rural Electrification Administrator David A. Hamil.

Some aspects of this picture of today's co-op are gained by implication, some by direct statement from the Administrator's talks to regional groups of co-ops.

This is the picture that emerges:

First, and perhaps most important, is the fact that today 94.2% of this country's farms are electrified. Inevitably, therefore, the new generation of people growing up on the farms will know only by hearsay whatever struggles there may have been to get electricity to the farm. The crusade mantle thus begins to fall away.

Customer Concerned With Rates, Reliability

Hamil cites his own case. While he has known the back-breaking job of scooping grain, his son today knows only the electrically-operated grain elevator. As Hamil says, his son is less concerned about where the electricity comes from than he is about reliability of service and cost. This will be increasingly true of all his generation.

"Cooperatives are an established part of the national electric power service industry. But to hold their position I believe they have to gear their operations to provide consumers with a maximum of service at competitively low cost," Hamil says.

The electric service industry, Hamil points out, is highly competitive and co-ops must be willing to meet all friendly competition. "This competition in service and price is a normal part of American business development. It results in weeding out of the weak and inefficient organizations," he says.

Hamil maintains that while it is true in most cases that the business of providing electricity is a monopoly, it is still highly competitive. "There is nearly always someone nearby who is ready and willing to step in."

Thus, says the Administrator, the co-ops most likely to disappear today are those which are not financially strong and are not doing the job of servicing customers at economical costs.

Co-ops Take on Industrial Load

Another aspect of the picture is the changing load of the co-op. According to Hamil, Congress in enacting the rural electrification law did not differentiate between farm loads and other types of loads. The passing years have seen the partial decentralization of industry with more and more plants coming into rural areas. If the co-ops are to provide adequate electric power service to all within their areas, the new and growing demand must be met. Also, in many areas, expanding suburban developments are meeting up with co-op territory.

Co-ops thus are facing the need to serve a new generation of farmers and new customers who will have little interest in the co-op as such but primarily in good electric service at low cost.

Co-ops can no longer afford to sit back "and talk of the glories of the past 20 years," concludes Hamil.

TECHNICAL NOTES

Splitting the bus and dividing multiple supply cables among bus sections boost impedance of low-voltage industrial plant distribution enough, in some cases, to accommodate considerable load expansion without exceeding fault-clearing capability of existing switchgear.

Mathematical approach to circuit breaker maintenance permits better scheduling of internal inspections. Plugged into the equation are factors for duty, number of operations, and importance.

Ultrasonic methods slice paper-thin wafers from quartz for electronic applications.

Transformers comprise 27 to 50% of industrial distribution cost, and primary feeders, with protection, add nearly as much. Careful selection of transformer rating and location is the key to economy.

Safe voltage for portable tools in hot, damp working locations such as chemical plants is claimed to be 50 v L-L from a center-tapped transformer limiting L-G voltage to 25. But dc is equally tolerable at 125 v L-G, according to British investigations.

Simple circuitry with high quality components has proved preferable to flexible complex systems for electrical reliability in industrial plants.

For mounting on transformers already in service, Alnico permanent magnet holds overload indicator on transformer tank. It will not creep or vibrate loose. The device provides an accurate yet economical overload indication.

New L-M Thermal Overload Indicator Easy To Install; Provides Constant Check

Simply attached and held by permanent magnet; provides continuous overload check; avoids service interruptions.

All you have to do is place the L-M thermal overload indicator against the transformer tank already in service, and it is installed. An Alnico permanent magnet holds the indicator firmly against the transformer tank. The indicator will not creep or vibrate loose. On new L-M Round-Wound® transformers the indicator is attached to a bracket permanently welded to the transformer tank.

This new device provides visible indication of overloads on conventional transformers up to 50 kva by means of a drop-down red light or drop-down luminescent tube. The luminescent type is provided with a nylon cord which can be attached to a cover bolt or other convenient projection to prevent the indicator from falling in the event the pole receives a severe shock.

Continuous Overload Check Without Interrupting Service

The L-M overload indicator provides an economical and reliable solution to load-study problems. It enables you to keep a continuous overload check on your distribution load and also eliminates the costly and laborious work required to take spot load checks.

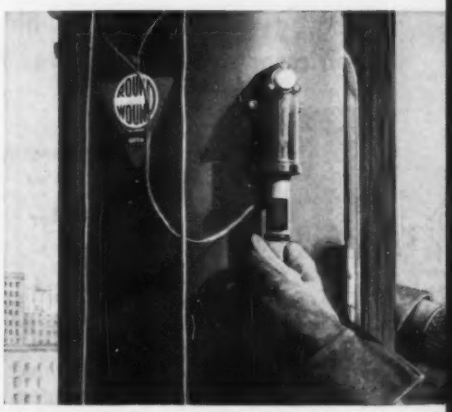
In addition, the indicator on a conventional transformer does not interrupt service. It serves as a tool to reduce transformer burnouts and maintain service continuity by indicating serious overloads before they can cause trouble.

Compensates For Ambient Temperatures

The overload indicator measures tank-wall temperature (a function of top oil and hot spot temperatures), and makes proper allowance in transformer loading for variations in ambient temperature. Accuracy is sufficient for all practical purposes.

Indication Easily Seen

The overload indicator is available with a red light or reflecting tape. Both types are exceptionally brilliant and easily distinguished in daylight as well as at night. Indicator with red light requires an electrical connection to the transformer.



Indicating target is easily seen during the day or night. It is quickly and easily reset by simply pushing the indicating tube up.

Get Complete Information

L-M overload indicators are available for mounting on transformers in service, with permanent magnet, or stainless steel wire to wrap around tank. On new L-M Round-Wound transformers, indicator is attached to a bracket permanently welded to the transformer tank. Ask the L-M Field Engineer for bulletins and complete information. Or write Line Material Company, Protective Equipment Division, Milwaukee 1, Wis.

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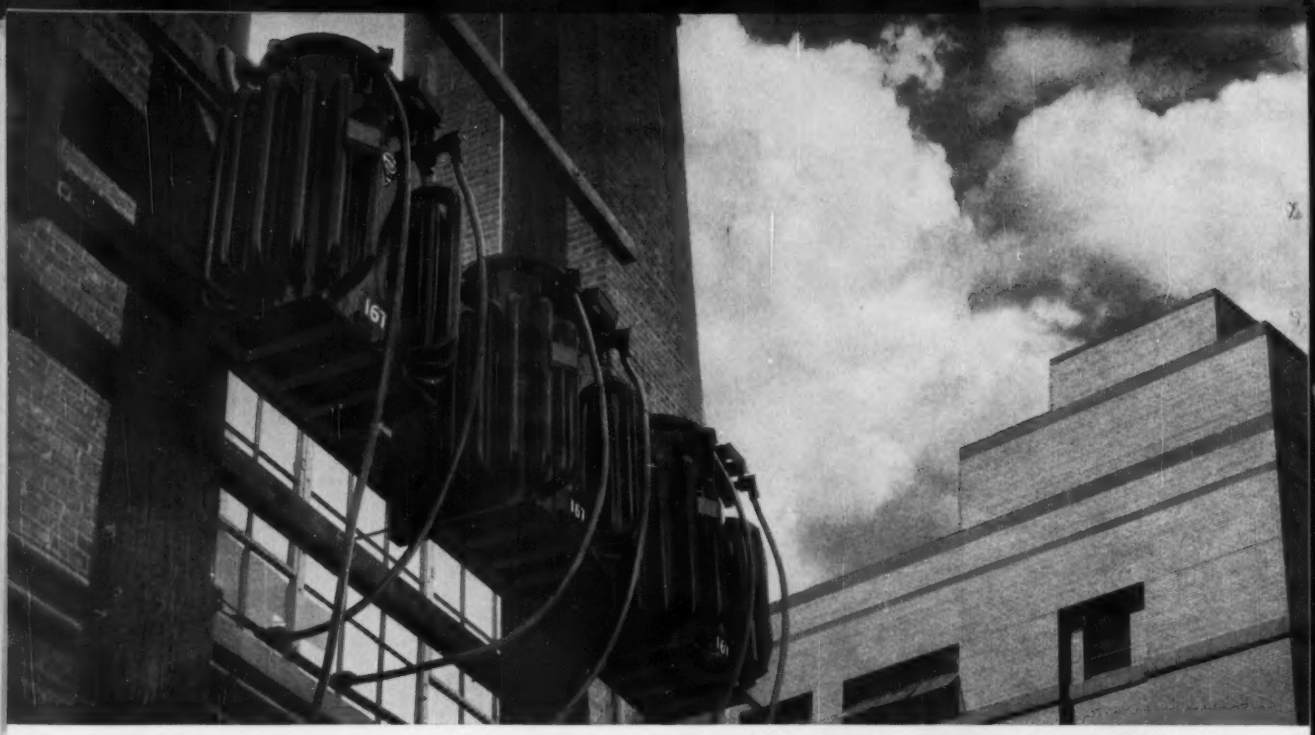
LINE MATERIAL Protective Equipment
A McGRAW ELECTRIC COMPANY DIVISION



L-M's Round-Wound transformers provide more capacity for heavier short-time overload without sacrifice in transformer life. Because L-M's obround design is lighter, smaller, and has less bending moment than round tank design, three 167's can be hung on a two-pole structure in place of three 100 kva transformers of older design.

For Heavier Commercial Loading

Why L-M Round-Wound® Transformers

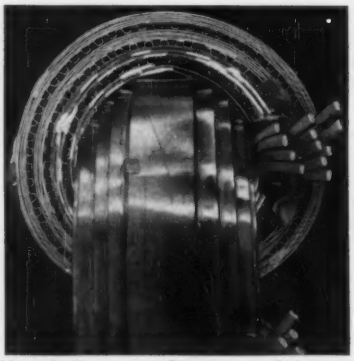
Core-type construction with cruciform cross-section core and round coils provides the most efficient design for lower hot-spot gradient, greater capacity for short-time overload.

By **ROBERT P. THOMPSON**
Manager of Engineering
Transformers
Line Material Company

One of the primary factors that limit the overload capacity of a transformer is the efficiency with which heat from the coils can be dissipated into the transformer oil. Particular care was taken, therefore, in the design of L-M Round-Wound transformers, to assure greatest exposure of coil surface area to cooling oil, and least obstruction to oil circulation.

Cruciform Cross-Section Core

The core is wound of a continuous strip of oriented steel, of varying widths, to form a core of nearly round cruciform cross section. The cruciform cross section of the core provides natural oil passages for cooling between core and coils.



Natural oil passages between cruciform core and round coil help to dissipate the heat from the coils more rapidly. In addition, ducts between windings and between layers in most sizes provide additional oil circulation.

Round Coils and Cooling Ducts

L-M's long round coils expose a relatively large and highly efficient area to cooling oil. Because of this, they provide greater overload capacity than rectangular coil types. In addition, ducts are provided for oil passages between windings and between layers in most sizes, giving exceptionally uniform cooling for the coils.

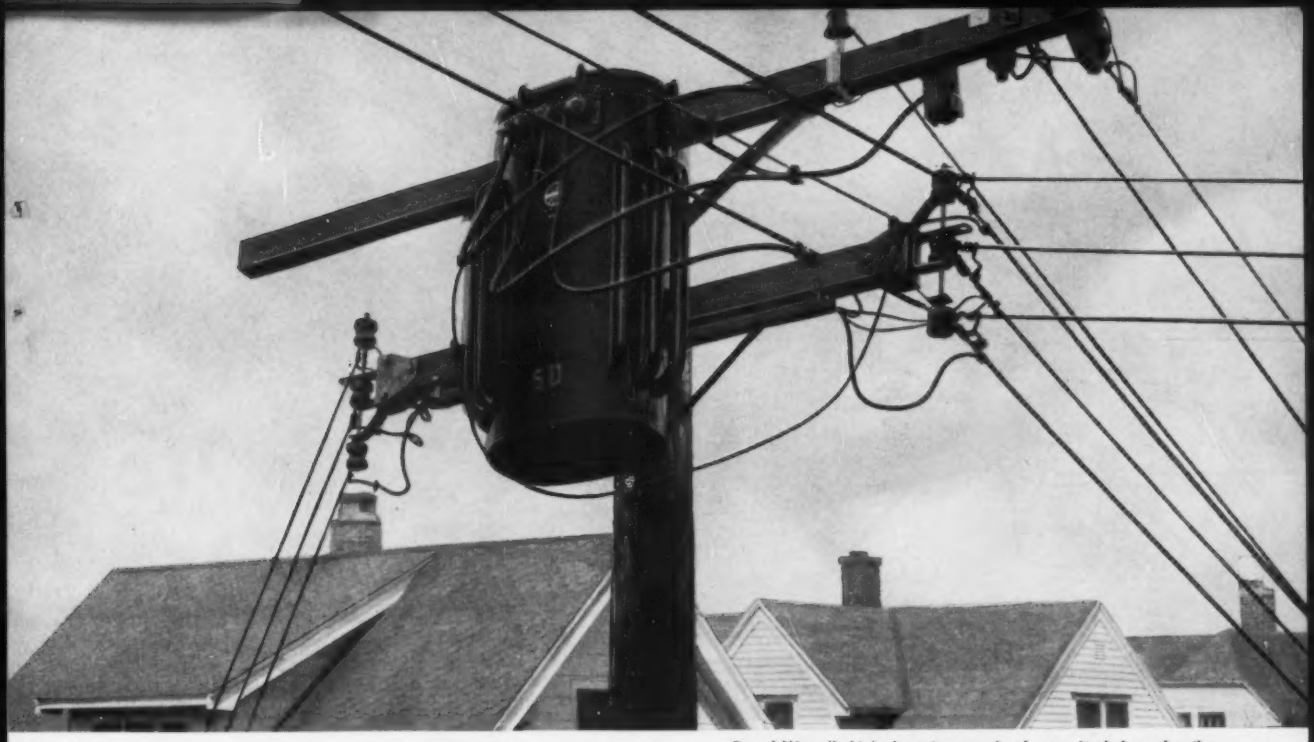
Core-Type Construction

In comparison with shell-type construction, L-M's core-type Round-Wound transformer has greater outer coil surface exposed to cooling oil; therefore coils are cooled more rapidly and uniformly. The cooling surfaces of shell types are partly blanketed by core steel; oil circulation is more obstructed.

Lower Hot-Spot Temperature, Higher Overload Capacity

Because L-M's Round-Wound design provides more efficient dissipation of heat from the coils to the oil, it has appreciably lower hot-spot temperatures during overload. This permits higher short-time overload, or longer overload periods, or greatly increased over-all life of the transformer.

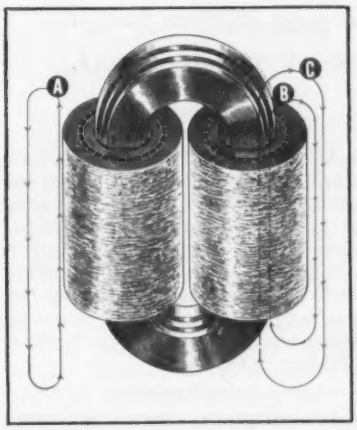
LINE MATERIAL
A McGRAW ELECTRIC COMPANY DIVISION



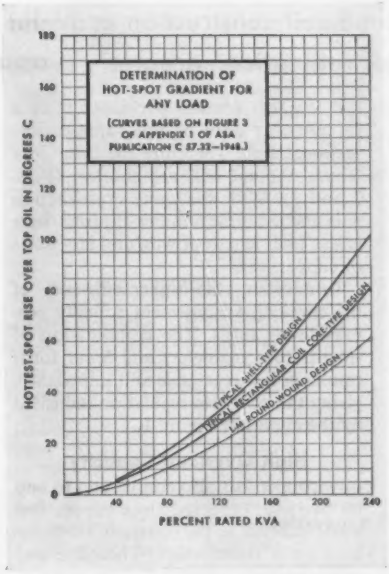
Round-Wound's high short-time overload capacity helps solve the more difficult *summer* overload problems in residential areas. The efficient cooling system in L-M transformers keeps hot-spot temperatures lower under high short-time overloads, increasing the capacity for overload and reducing the possibility of insulation damage.

For Heavier Residential Loading

Have Higher Overload Capacity



Because L-M transformers expose large, unobstructed areas to cooling oil on the outside of the coil (A), between core and coil (B), and between windings and layers (C), heat is dissipated into oil more rapidly and uniformly during overloads.



The higher the gradient at rated load, the more rapid is the rate of increase in the gradient with overload. Note that L-M's Round-Wound transformer, with a lower temperature differential (gradient) between hot-spot and top oil at rated load, has a greater capacity for overload.

Get Complete Information

Ask your L-M Field Engineer for complete information on L-M's Round-Wound design, and bulletins. Or write Mr. Thompson at Line Material Company, Transformer Division, Zanesville, Ohio.

Five Reasons Why More Customers Are Selecting L-M Round-Wound Transformers

1. Higher Uniform Impulse Level: Round coils are *wound* into shape. Therefore insulation is not damaged by malleting into rectangular shape. Coils have longer creepage distance between windings and between leads.

2. Higher Short-Circuit Strength: Round coils are not stressed out of shape under high radial short-circuit forces. Strong steel frame, heavy clamping bolts, sturdy maple blocks and varnished coils prevent axial movement.

3. Higher Short-Time Overload Capacity: Round coils and the cruciform cross-section core expose large surfaces to cooling oil. The result is relatively low hot-spot temperatures, which add considerably to high short-time overload capacity.

4. Balanced Performance: The core is a continuous wound strip of oriented steel. Coils are wound directly onto this core. Since the core is not cut, unwound, or disturbed in any way after annealing, there are no air gaps to break up the flux path. This results in low exciting current and core loss.

The wound-core, round-coil design permits fewer winding turns and smaller turn diameter. This results in low impedance, and provides better regulation at all power factors.

5. Additional Capacity on Pole: L-M's new obround tank design makes the unit smaller and lighter, with shorter moment arm from the pole. This combination reduces the bending moment on the pole and crossarms, and thus greatly increases the potential capacity of existing transformer structures.

Transformers

L-M transformers provide balanced performance which results in low losses. Extremely quiet operation is another advantage. L-M's new obround tank design, shown here, retains all outstanding Round-Wound performance characteristics.

How L-M's Round-Wound® Design Assures Consistently Low Losses, Greater Revenue

L-M's wound-core, round-coil construction provides the most efficient design for low losses, good regulation, greater revenue at all power factors.

By **R. W. HARTSOOK**
Chief Engineer
Small Distribution
Transformers
Line Material Company

One of the most important objectives in transformer design is to achieve a balance of low copper loss, low exciting current, and low core loss without sacrificing other desirable performance characteristics. The Round-Wound design has many inherent advantages that aid the designer in achieving this objective.

Round-Wound Design Offers Balanced Performance

L-M's Round-Wound transformer design consists of a wound core, with a cruciform cross section closely approximating a round form. Long round coils are wound directly onto the wound core. This construction gives L-M transformers inherent advantages to minimize losses and offer balanced performance.

Low Copper Loss

In the Round-Wound transformer, the core cross section is nearly round. As shown in Figure 4 at right, a round core has a much smaller perimeter than a rectangular core of the same cross-sectional area. Therefore the turns in a Round-Wound coil are shorter. (Figs. 2 and 3). With the same cross-section wire and the same number of turns, there is less total length of wire and less watts of copper loss.

In addition, the higher efficiency of the core-coil arrangement actually permits fewer turns. The combination of smaller turn diameters and fewer turns results in low reactance and impedance, giving the desirable regulation indicated by the curves in Figure 1.

High Overload Capacity

Low copper loss also contributes to better overload capacity, since copper loss watts increase as the square of the overload on a transformer. Therefore any reduction in copper loss results in a substantial increase in overload capacity. This is a bonus over the excellent overload capacity of the Round-Wound transformer resulting from its exceptionally good cooling characteristics.

Low Exciting Current, Low Core Loss

L-M's core is tightly wound of a continuous strip of oriented steel. Coils are wound directly onto this core by means of L-M's exclusive winding machine. Since the core is not cut, unwound, or disturbed in any way after annealing, there are no air gaps to break up the flux path. This construction results in low exciting current and high magnetic efficiency of the core.

Quiet Operation

L-M's wound-core construction eliminates all laps, flaps and gaps in the laminations. This contributes greatly to the extremely quiet operation of L-M's Round-Wound transformer.

Get Details on L-M's Round-Wound Transformers

Ask the L-M Field Engineer for complete information on L-M's Round-Wound design, and bulletins. Or write Line Material Company, Transformer Division, Zanesville, Ohio.

LINE MATERIAL
A McGRAW ELECTRIC COMPANY DIVISION

L-M's wound-core, round-coil construction provides exceptionally good cooling for high overload capacity and almost an ideal magnetic circuit to minimize losses.

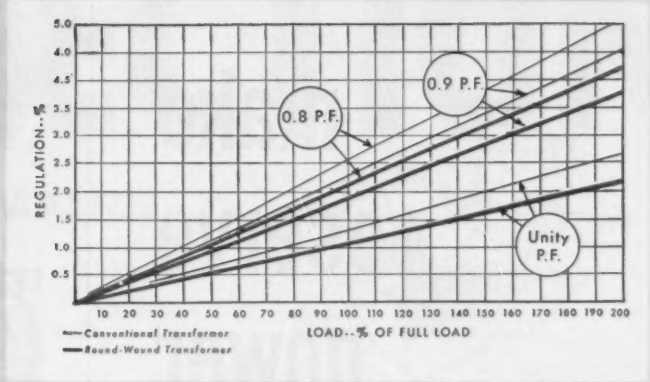


Fig. 1. Round-Wound offers good regulation at all power factors. Regulation of new 25 kva 2400-120/240 volt Round-Wound transformer compared with that of older design, showing effect of load and power factor on regulation. Multiply the difference in regulation by the number of old distribution transformers on your system, and see how much more revenue these modern L-M transformers produce.

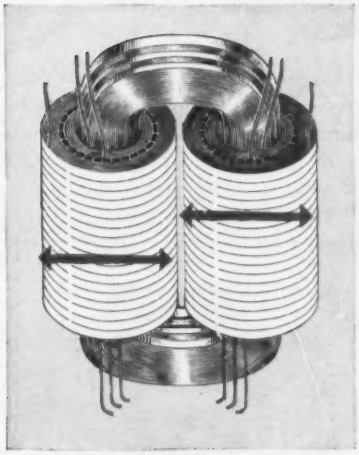


Figure 2. Round-Wound Design

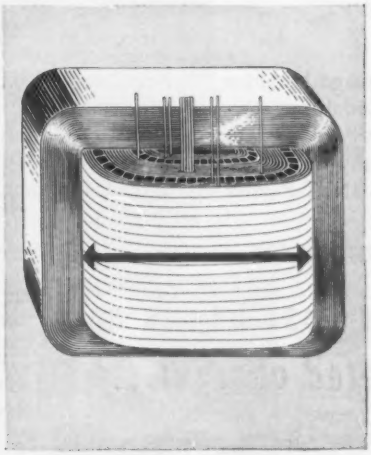


Figure 3. Shell-Type Design

Compare the difference in mean-turn diameter. L-M's Round-Wound design with the long round coils has a lower mean-turn diameter than a shell-type design. This contributes to L-M's low losses, which in turn result in good regulation, greater revenue at all power factors.

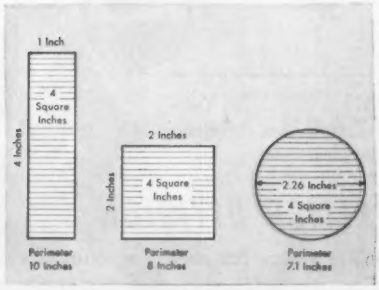


Figure 4. Compare the difference in perimeter. Each of these core cross sections has an area of 4 square inches. It takes only 7.1" of wire to make a turn around the core of round cross section typical of L-M transformers. This results in better utilization of copper, lower copper loss.

Five Reasons Why More Customers Are Selecting L-M Round-Wound Transformers

1. Higher Uniform Impulse Level: Round coils are *wound* into shape. Therefore insulation is not damaged by malleting into rectangular shape. Coils have longer creepage distance between windings and between leads.

2. Higher Short-Circuit Strength: Round coils are not stressed out of shape under high radial short-circuit forces. Strong steel frame, heavy clamping bolts, sturdy maple blocks and varnished coils prevent axial movement.

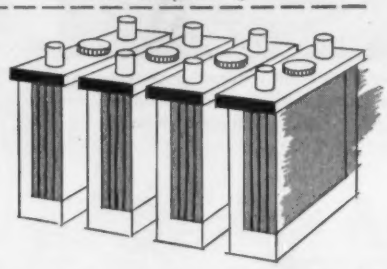
3. Higher Short-Time Overload Capacity: Round coils and the cruciform cross-section core expose large surfaces to cooling oil. The result is relatively low hot-spot temperatures, which add considerably to high short-time overload capacity.

4. Balanced Performance: The core is a continuous wound strip of oriented steel. Coils are wound directly onto this core. Since the core is not cut, unwound, or disturbed in any way after annealing, there are no air gaps to break up the flux path. This results in low exciting current and core loss.

The wound-core, round-coil design permits fewer winding turns and smaller turn diameter. This results in low impedance, and provides better regulation at all power factors.

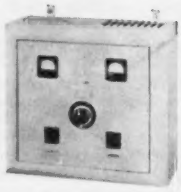
5. Additional Capacity on Pole: L-M's new obround tank design makes the unit smaller and lighter, with shorter moment arm from the pole. This combination reduces the bending moment on the pole and crossarms, and thus greatly increases the potential capacity of existing transformer structures.

make reserve power positive power



It's common practice to depend on storage batteries whenever *power must not fail.* But, dependable as storage batteries are, you have to be sure they are *ready* to deliver power at a moment's notice . . . any time. Your best insurance of such readiness is an INET-Palmer *Regulated* Battery Charger. Completely unattended, they guard your reserve batteries against sulfation and discharge . . . make sure 24 hours a day that standby power, on those once-a-year occasions when it's needed, is ready for immediate use.

6 reasons why your best buy is an INET-Palmer *regulated* charger...



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EASY INSTALLATION . . . floor (right), wall (left), or panel models available.

WIDE RATING RANGE . . . 3 to 60 cells in ratings to 50 KW.

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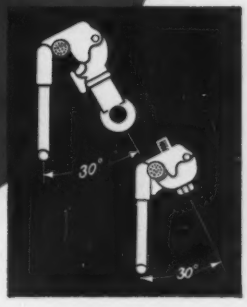

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FOR MORE COMPLETE INFORMATION consult your nearest ANDERSON representative or contact our home office.

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DISTRIBUTION TRANSFORMERS

THIS PAINT

COULD SAVE YOU $15 to $160

Estimate your possible savings in terms of all transformers on your lines

Super Melaglyp, the new G-E paint, gives 50 per cent longer life than the previous finish under normal conditions, and up to 150 per cent longer life under corrosive conditions. This longer paint life means that you save one, perhaps two repaintings. At an average repainting cost of $15 per transformer, that amounts to a real saving.

In areas where corrosive industrial "smog" and other chemical fumes literally eat an ordinary finish down to the base metal, Super Melaglyp makes possible even more dramatic savings. For ordinary paints under such conditions may even cause a transformer to fail. In one case, a 5-kva, 7200-volt transformer, battered by spray in a remote seacoast location, rusted, leaked, and failed. Cost of service trip plus replacement added up to $160.

Developed in G-E laboratories after more than four years of experimentation, we believe Super Melaglyp is by far the best outdoor finish available today for distribution transformers.

Look at the other money-saving features that prove "All Transformers Are Not Alike": **Impulse testing,** for instance, saves years of transformer life. One-piece **clamping bands** save maintenance time. Reuseable **Nitrile rubber gaskets** save units from contamination. **AL/CU terminals** are designed to prevent both copper and aluminum conductors from loosening. **Strenicor clamps** save terminals from breaking. **Nationwide warehouses** save utilities inventory expense. **Service shops** can cut your repair and rebuilding costs.

For the complete story contact your nearest G-E Apparatus Sales Office or G-E Agent—or write to General Electric Co., Schenectady 5, N. Y. 431-38

dollar-saving features prove ATANA*

*ALL TRANSFORMERS ARE NOT ALIKE
(make this simple comparison and see)

FEATURE	General Electric	Mfr. A	Mfr. B	Mfr. C	Mfr. D	Mfr. E
Production-line impulse testing	√			√		√
Nitrile rubber gaskets	√					√
One-piece clamping band	√					
H-v and l-v terminals handle both copper and aluminum conductors	√					
Strenicor pressure terminal clamps	√					
Super Melaglyp paint	√					
More than 100 warehouses	√	√				
Nationwide, company-operated service shops	√	√				

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Bechtel, in the mainstream of engineering, technological and industrial developments, has good reason to know that as great as are today's opportunities for the technically trained man, tomorrow's will be greater.

America is the winner every time engineering gains another recruit.

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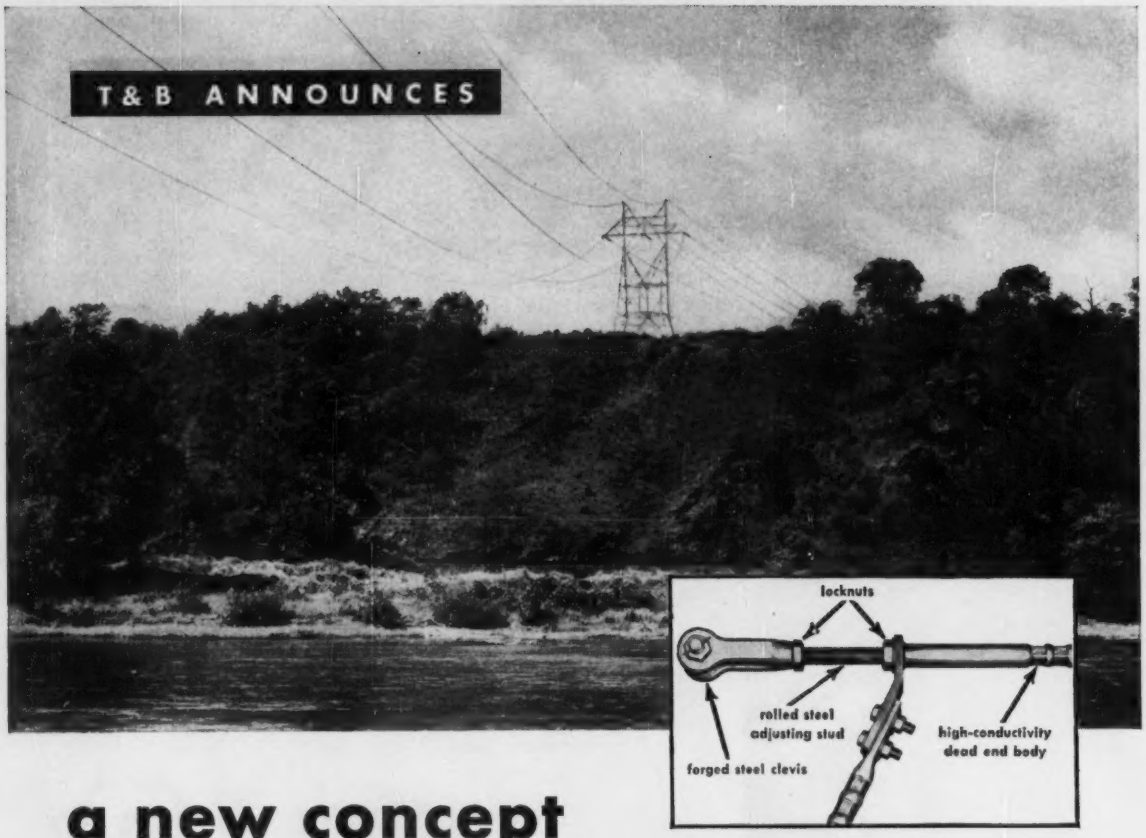

a new concept in transmission dead ending!

DEAD END CONNECTORS PERMIT SAG CORRECTION AFTER JOINT IS COMPLETED

Now you can adjust conductor sag to specification after the strain connection has been made! Four inches of clevis adjustment available provides great sag adjustment. For example: in a 700 foot span of 795,000 CM A.C.S.R. sagged at 50% of ultimate strength, the 4 inch clevis adjustment will allow 4 feet of sag adjustment.

The new dead end connector gives many important advantages: transmission line dead ending at river crossing and over rough terrain is simplified, more economical; "bundled" cables can be easily sagged with complete uniformity; line measurement errors can be readily compensated.

T&B Dead Ends are available for all commercial sizes of A.C.S.R. and all-aluminum conductors in three types: single bolting pad, double bolting pad, and with an integral compression loop connection.

For complete specifications on the new dead ends, as well as the complete new catalog of T&B Method transmission line connectors, tools and accessories, send the coupon below.

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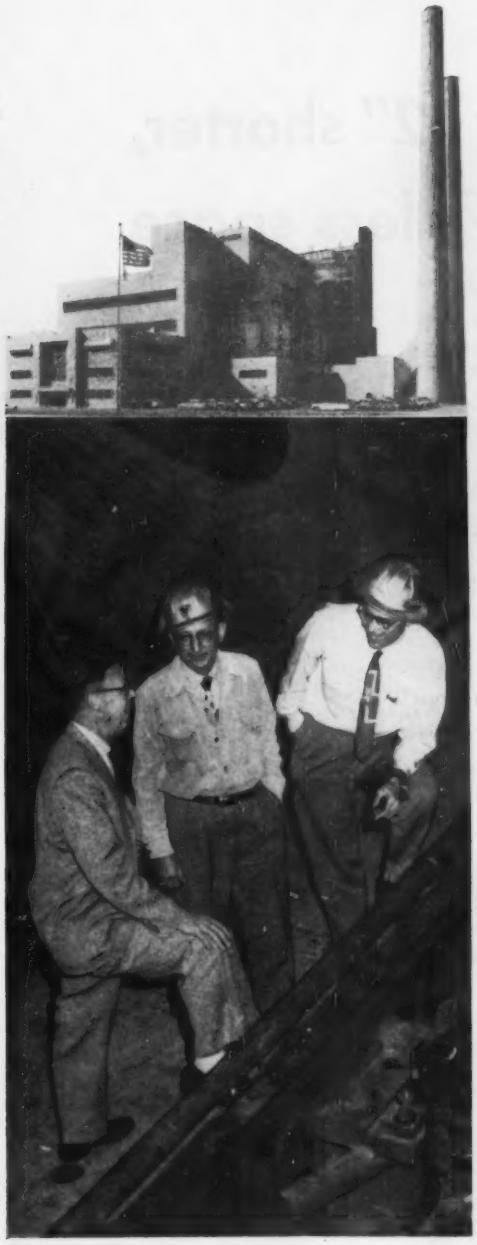
How Oklahoma Gas & Electric came to select NONPAREIL Turbine Oil

Laboratory tests result in selection of turbine oil with life-of-turbine guarantee



Oklahoma Gas & Electric Company conducted laboratory tests on a number of turbine oils before finally deciding which oil to use in the turbines at the Company's Mustang and Riverbank stations. NONPAREIL was chosen. OG&E received an oil which is guaranteed for the life of the turbines.

This is why it is possible for NONPAREIL Turbine Oil to carry such a guarantee. Petroleum oil normally contains two types of molecules. One relatively stable type oxidizes to acids. The other less stable type, containing natural inhibitors, forms asphaltenes when combined with oxygen. In making base oil for NONPAREIL Turbine Oil, the asphaltenes or sludge forming type of molecule is removed completely. Oxidation inhibitors, added to the special base oil, stop acid formation. Result is: sludge forming parts having been removed; acid forming is fully controlled.

The inhibiting of acid formation in NONPAREIL is so complete that Standard Oil can guarantee that for the life of the turbine, the neutralization number of the turbine oil will never exceed 0.15 mg. KOH/g.

Get the facts about NONPAREIL Turbine Oil from your nearby Standard Oil industrial lubrication specialist in any of the 15 Midwest or Rocky Mountain states. Or write Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY
(Indiana)

STANDARD

Quick facts about
NONPAREIL Turbine Oil

- Does not form harmful acids.
- Does not form sludge.
- Maintains excellent demulsibility.
- Guaranteed for the life of the turbine.

(l. to r.) John Thornquist, Standard Oil industrial lubrication specialist with OG&E men J. W. Blake, superintendent of generation, D. O. Lima, chief testing engineer and W. D. Brewer, chief engineer, inspect turbo-generator at Mustang plant.

At Riverbank station, John Thornquist talks to George Gibbons and L. E. Cahill, asst. chief and chief engineer respectively. John Thornquist is well qualified to work with utility men on turbine lubrication. He's been doing this work for 19 years with Standard. In addition he has an engineering degree from the University of Minnesota and has graduated from the Standard Oil Sales Engineering School.

New space-miser network transformer now 12″ shorter, 20% lighter, occupies 15% less space

Slashing maintenance a dozen ways is the story of the new Westinghouse 500-kva subway transformer. Easier servicing and even better electrical performance place this product in a class by itself.

1. Protection against partial vault flooding—with a 12″ reduction in height, transformers can now be off the floor, set on I beams.

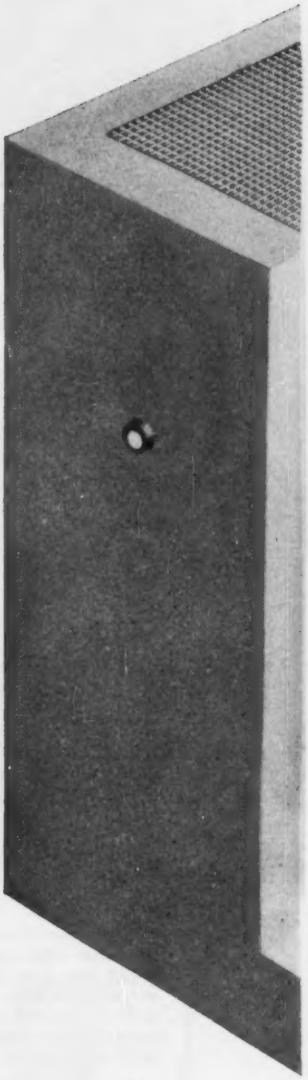
2. Installation easier, handling safer—new transformer is 20% lighter.

3. Contoured . . . round corners replace sharp edges on new diving bell tank.

4. Easier to wash down and paint, virtually self-cleaning—new contour design of Yukon Coolers eliminates 68 former sources of corrosion.

5. More accessible high-voltage terminal chamber—exclusive integral tank design lowers switch compartment; switch and core-coil assembly now housed in one smooth, unwelded exterior on a common base plate.

For network transformers that set the standard, talk to your Westinghouse sales engineer, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-70781



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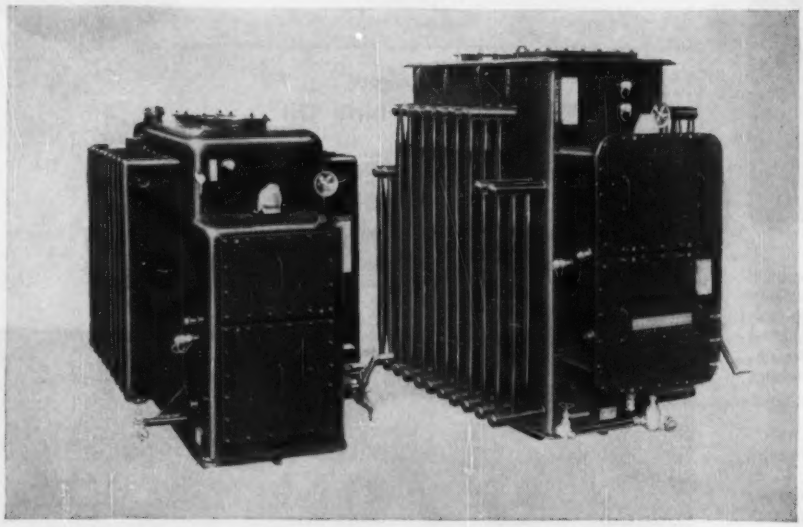
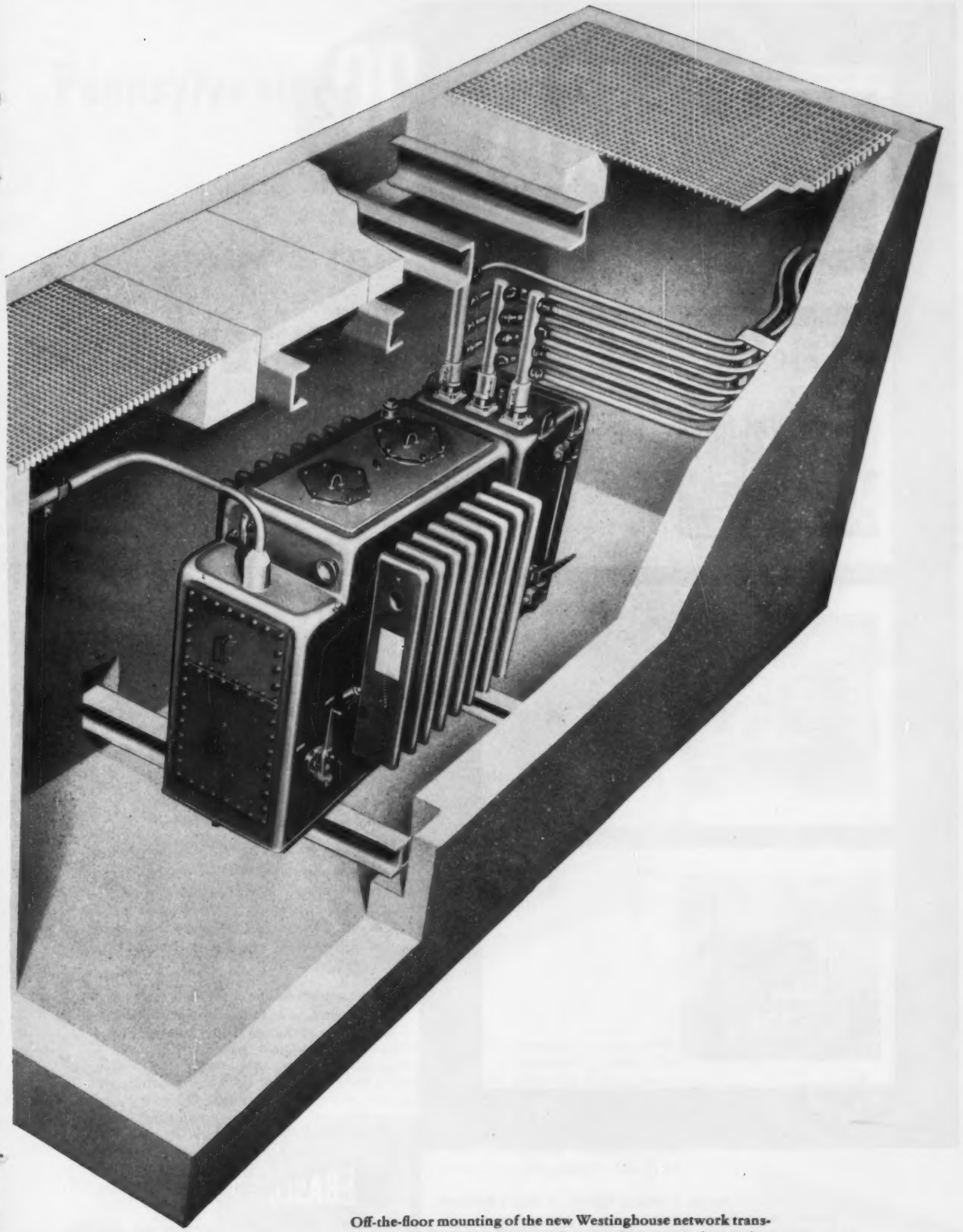
*WHERE **BIG** THINGS ARE HAPPENING FOR **YOU**!*



(*Right*) Previous 500-kva network subway transformer. (*Left*) New Westinghouse design features exclusive Yukon Coolers, greater spacing, more clearance to floor—refinishing is no problem.



Off-the-floor mounting of the new Westinghouse network transformer minimizes contact with corrosive matter; inspection and maintainance are quicker, easier.

THEY ALL CARRY THE SAME STAMP OF QUALITY

Among the two billion dollars of plants Ebasco has engineered and constructed in the past half century are steam plants of all sizes for many of the world's foremost utility companies.

Yet there is one thing that's common to all.

Different as the plants may be in size, location, design—the stamp of Ebasco *quality* marks each one.

Ebasco has long been a leader in the development of outdoor steam stations and has pioneered many engineering advancements in utility plant construction. And Ebasco's team of experienced engineers can demonstrate that quality engineering and construction cost no more.

For a complete outline of the services Ebasco offers, write for our booklet, "The Inside Story of Outside Help." Address: Ebasco Services Incorporated, Dept. M, Two Rector Street, New York 6, New York.

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NEW YORK
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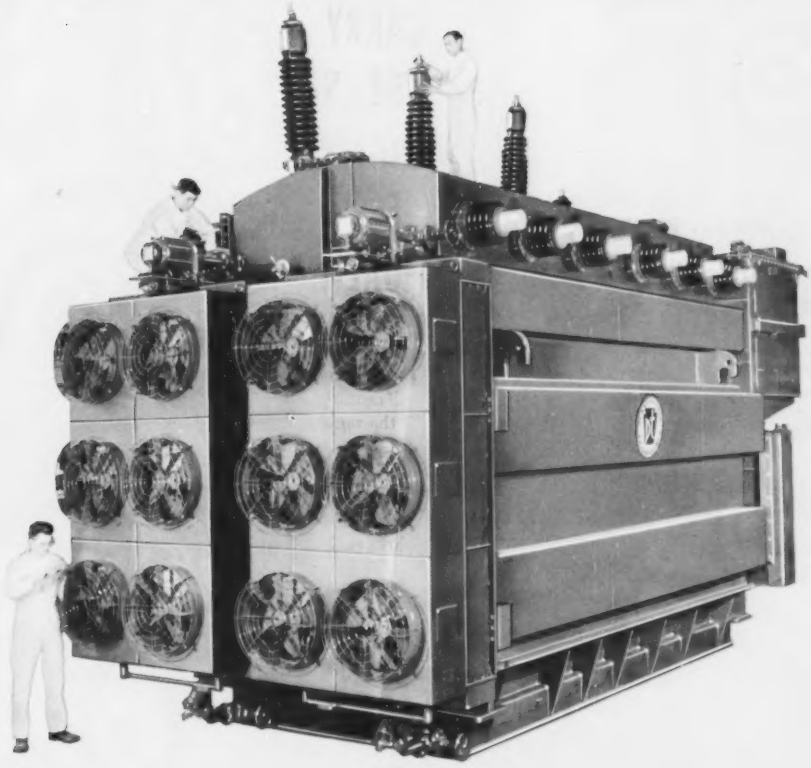
Pennsylvania **260,000 Kva** contour design shell form

MAIN STEP-UP

Generating Station Transformer



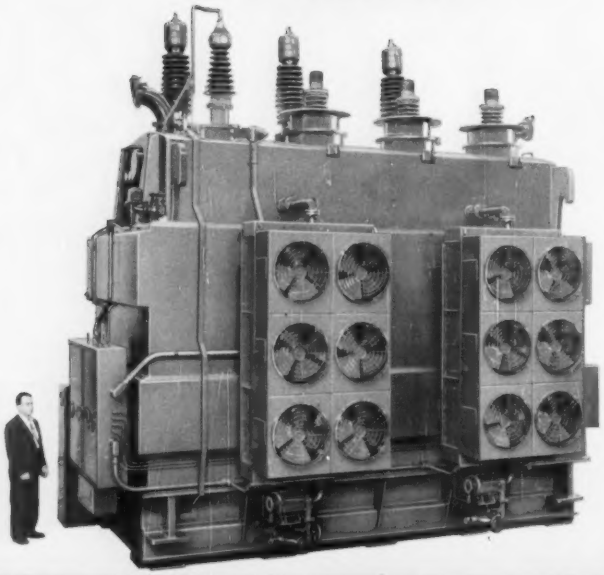
designed and built for upright shipment in one piece

This large three-phase, main step-up generating station transformer was designed and manufactured by Pennsylvania for a midwestern utility. The transformer will step-up a generated voltage of 15,000 volts to a transmission voltage of 141,000 volts. Two low voltage sections of 15,000 volts are rated at 130,000 kva each. Six of Pennsylvania's own Sealmaster Pumps circulate oil through the core and coils and through six coolers. Contour in design, so therefore compact in size, the transformer (less coolers and bushings) was shipped upright in one piece on a depressed center car. A duplicate unit is on order for the same company.

PENNSYLVANIA TRANSFORMER COMPANY
A McGraw Electric Company Division CANONSBURG, PA. Greater Pittsburgh District

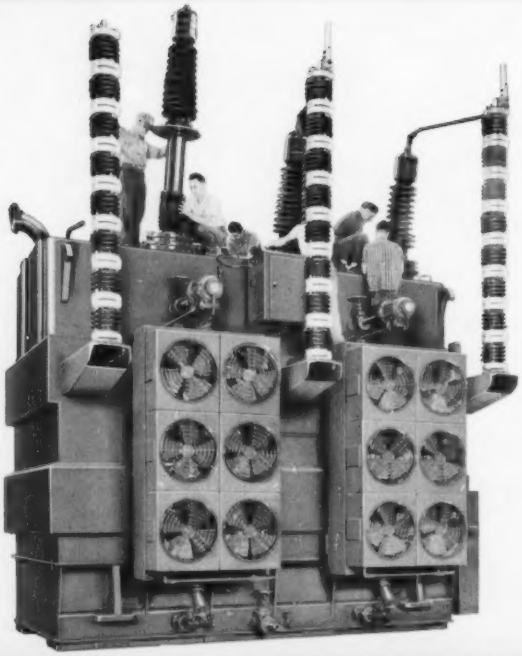
Pioneer in 1-piece upright shipment of large Power Transformers

Main Step-up GENERATING



175,000 Kva

High Voltage: 115,500 Grd. Y volts
Low Voltage: 17,500 Delta volts
Oil-immersed, forced-oil-cooled with forced-air cooler



140,000 Kva

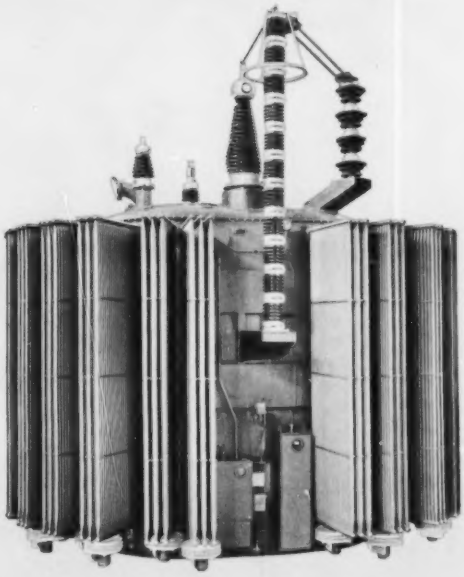
High Voltage: 115,000 Grd. Y volts
Low Voltage: 14,700 Delta Volts
Oil-immersed, forced-oil-cooled with forced-air-cooler

STATION AUXILIARY Transformers

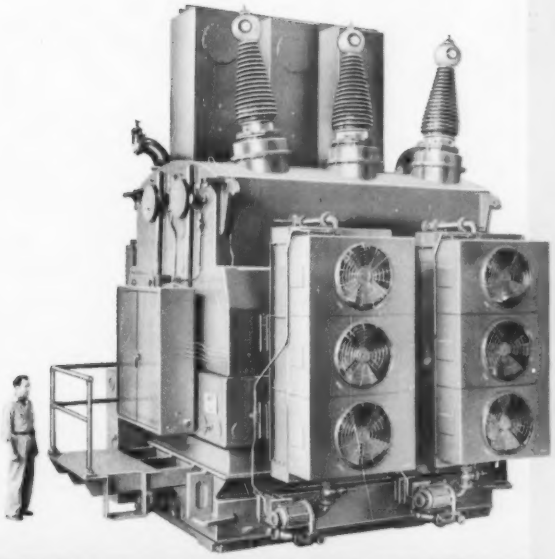
2000 Kva Silicone-Insulated Dry-Type Transformer

Just as Pennsylvania led the way in one-piece shipment of large power transformers, the company also pioneered the development of silicone-insulated units — the fire- and explosion-resistant transformers that are safest of all for both indoor and outdoor installations.

The 2000 kva station auxiliary transformer pictured is a sealed-in nitrogen, dry-type unit; three phase, 60 cycles, 150°C. temperature rise; 2400Δ–480Δ volts.



STATION TRANSFORMERS by PENNSYLVANIA



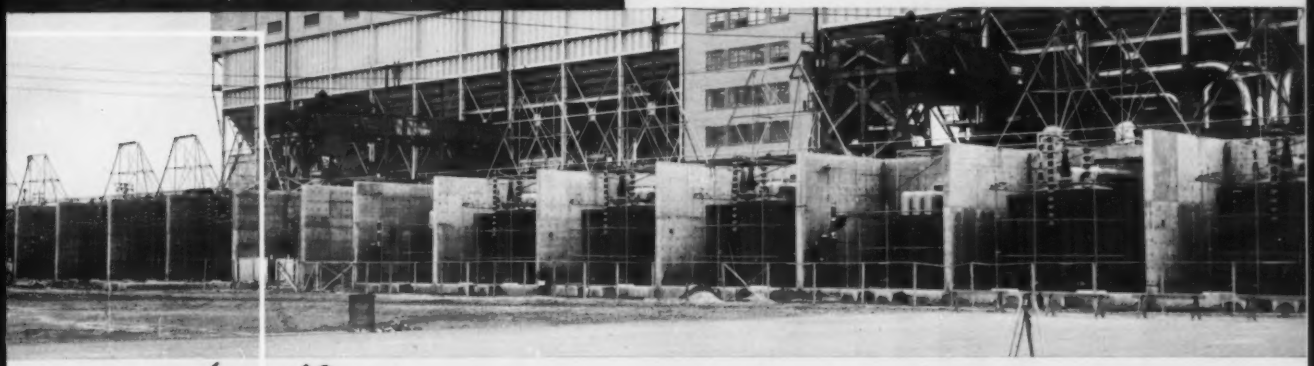
120,000 Kva

High Voltage: 145,000 Grd. Y volts
Low Voltage: 19,800 Delta Volts
Oil-immersed, forced-oil-cooled with forced-air cooler

From the standpoint of kva capacity, the three main step-up transformers pictured at the left can be classified as "large." They range in ratings from 120,000 kva to 175,000 kva. In physical size, however, their dimensions and weights were kept well within the limits for one-piece, upright shipment. This was possible because of the compact characteristics of Pennsylvania's own "contour design," shell form construction.

The units traveled to their respective installation sites in an upright position, with only bushings, cooling equipment and certain accessories removed. This meant easier handling in the field, with greatly reduced installation time and costs.

As the pioneer of one-piece upright shipment of large power transformers, Pennsylvania has long been offering this time-saving, cost-cutting advantage with core form transformers also.



These 19 56,000/70,000 kva main step-up generating station transformers, of core form design, were shipped to their destination in an upright position, completely assembled except for bushings and detachable radiators. Of single-phase construction, these transformers have a high voltage rating of 93,000/161,000 Grd. Y volts with a low voltage rating of 19,000 volts.

PENNSYLVANIA TRANSFORMER COMPANY
A McGraw Electric Company Division **CANONSBURG, PA. Greater Pittsburgh District**

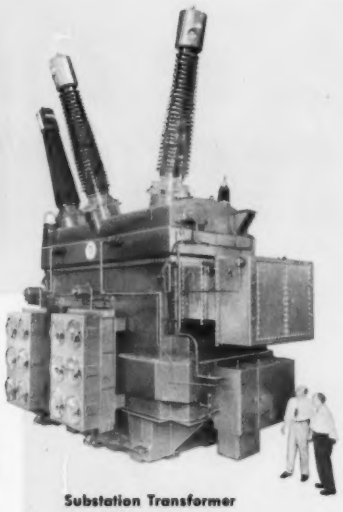
Core form or Shell form

Pennsylvania builds both types of transformers for Generating Station and Substation Service

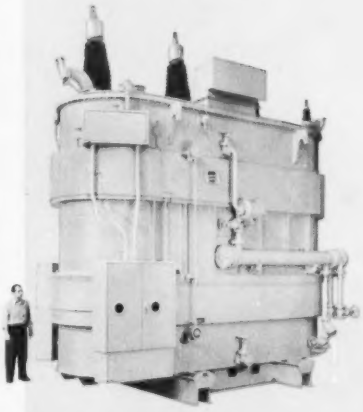
With wide experience in both shell form and core form design, Pennsylvania Transformer engineers are able to provide the transformer that is best suited to every application. Full consideration is given to size and weight, ease of installation, impedance, resistance to short circuit stresses, insulation strength, method of cooling, and other characteristics which result in definite advantages in a given kva and voltage for one design or the other.

Core form or shell form? Why not let the answer for your next transformer be based on Pennsylvania's proved principles of power transformer design?

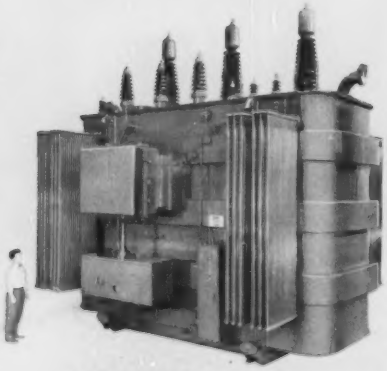
PENNSYLVANIA TRANSFORMER COMPANY
A McGraw Electric Company Division
CANONSBURG, PA. Greater Pittsburgh District



Substation Transformer
100,000 Kva, 3 Phase,
With load tap changing equipment
High Voltage: 330,000 Grd Y volts with ±10% regulation in 32 steps of ⅝%
Low Voltage: 14,400Δ volts

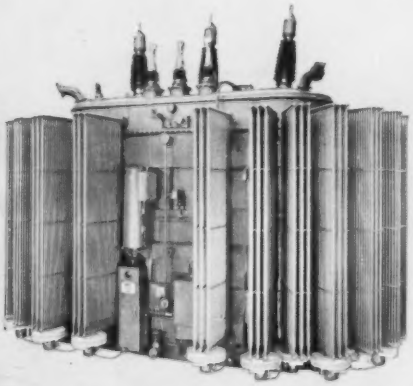


Generating Station Transformer
48,000 Kva, 3 Phase
High Voltage: 115,000 Grd Y volts
Low Voltage: 13,200Δ volts



Substation Transformer
15,000 Kva, 3 Phase, with load tap changing equipment
High Voltage: 154,000Y volts
Low Voltage: 69,000 Grd Y volts with ±10% regulation in 32 steps of ⅝%
Tertiary Voltage: 12,470Δ volts

Substation Transformer
30,000 Kva, 3 Phase, with load tap changing equipment
High Voltage: 66,000Y volts, with plus and minus 5% regulation in 32 steps of ⅝%
Low Voltage: 33,000Y volts
Tertiary Voltage: 13,800Δ volts



Generating Station Transformer
56,000/70,000 Kva, 3 Phase
High Voltage: 132,000Y volts
Low Voltage: 15,000Δ volts

CABLE TAPE

FRICTION TAPE

Specify

CHASE

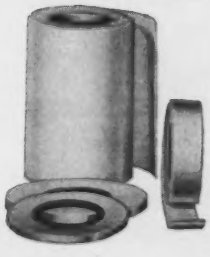
ELECTRICAL INSULATING MATERIALS

PLASTIC TAPE

NEOPRENE TAPE

RUBBER TAPE

LAMINATED INSULATING MATERIALS



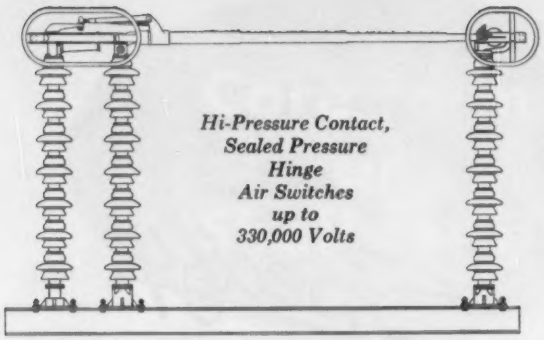
There is a difference in electrical insulating tapes, and you can be sure of top quality when you specify Chase. All Chase tapes are made to meet the high standards of the electrical industry and offer excellent electrical and physical properties, with guaranteed footage in every roll.

Chase also has pioneered in the development of Class "H" and Class "B" laminated insulating materials of purified asbestos and DuPont Mylar ® in a variety of combinations for original equipment insulation.

Write today for your copy of the handy Chase Insulation File describing the complete line. Chase & Sons Inc., Randolph, Mass.

Write for CHASE

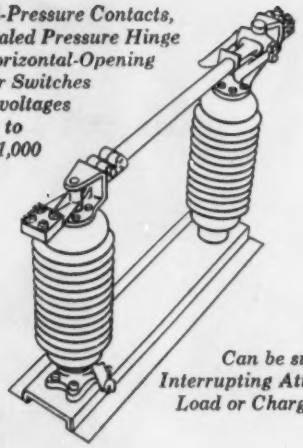
Electrical Insulation File



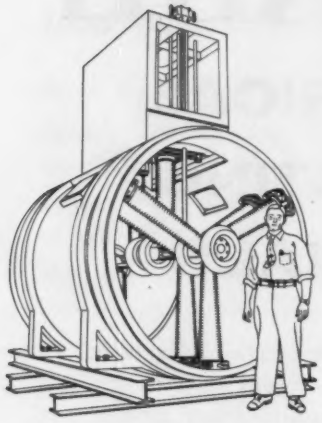
Hi-Pressure Contact, Sealed Pressure Hinge Air Switches up to 330,000 Volts

Can be supplied with interrupting attachments

Hi-Pressure Contacts, Sealed Pressure Hinge Horizontal-Opening Air Switches in voltages up to 161,000



Can be supplied with Interrupting Attachments— Load or Charging Current

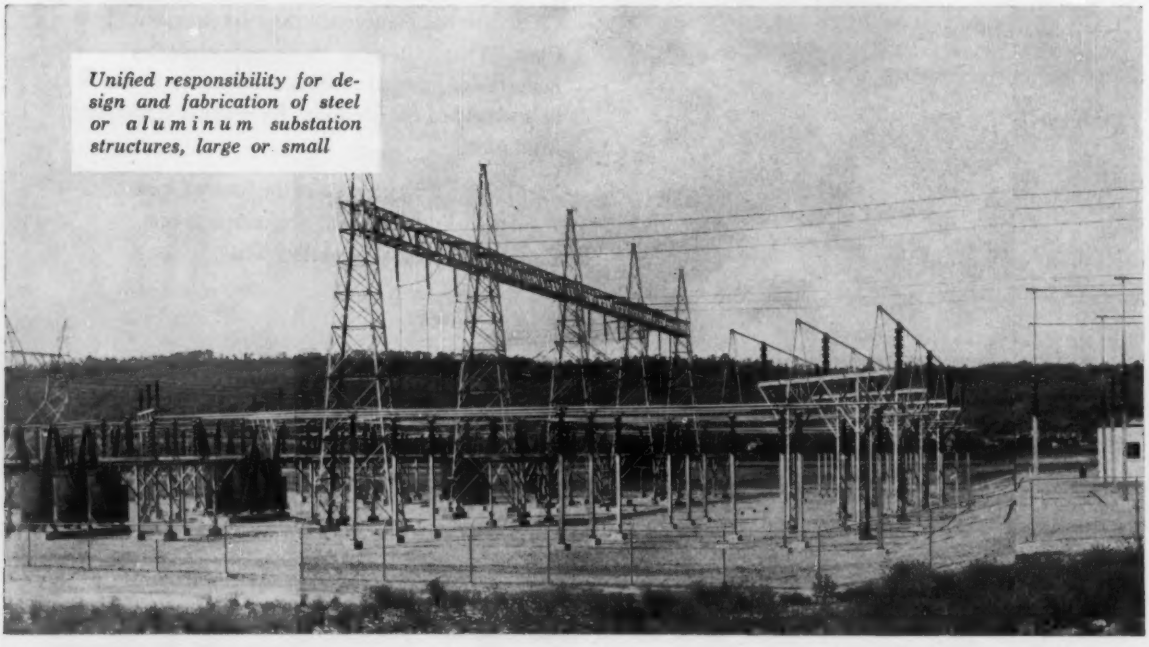


Isolated Phase Bus and Switches, all ratings up to 138,000 Volts

R&IE HAS A STAKE IN THE FUTURE OF INVESTOR-OWNED UTILITIES

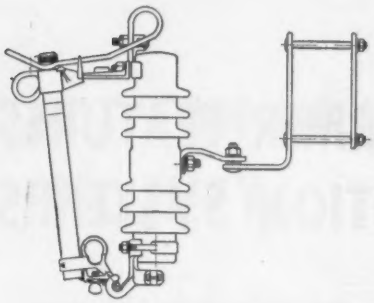
In 1910, R&IE became a pioneer in the Electric Power Industry—with the first horn gap air switch. In the following forty-five years, R&IE contributed many of the equipment "firsts" that improved electrical service. R&IE is dedicated to continued search for original and more efficient switching devices.

Power Systems are only as good as the equipment on them. The R&IE Research and Development Program vigorously established a big stake in the growing investor-owned power industry.

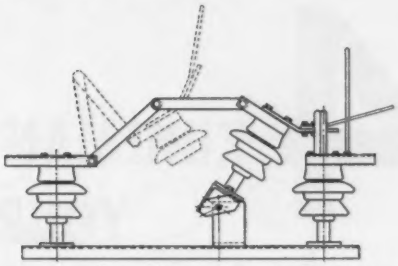


Unified responsibility for design and fabrication of steel or aluminum substation structures, large or small

Open Type and Load Break Cutouts



Tilting Insulator Shuntless Distribution Switches, in voltages up to 34,500



Can be supplied with Load Break Attachments

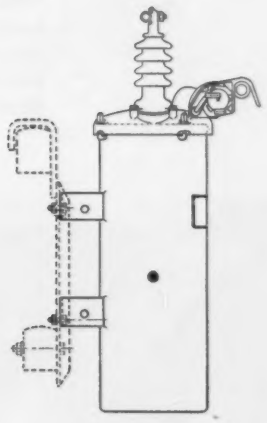
FROM THE R&IE RESEARCH LABORATORY

Famous R&IE Firsts . . .

1—"Burke" Air Switch **2**—Interchangeable Insulator Units **3**—Hi-Pressure Contact Switches **4**—Isolated Phase Bus **5**—Power Class Automatic Circuit Reclosers **6**—Sealed Pressure Hinge Contacts **7**—Cam-Type High Current Disconnecting Switches

Famous R&IE Futures . . .

1—Wider Application of Interrupting and Load Break Devices **2**—Higher Continuous and Momentary Capacity **3**—Higher Voltages, with its problems of Gap Distances, Phase Spacing and Withstand Values

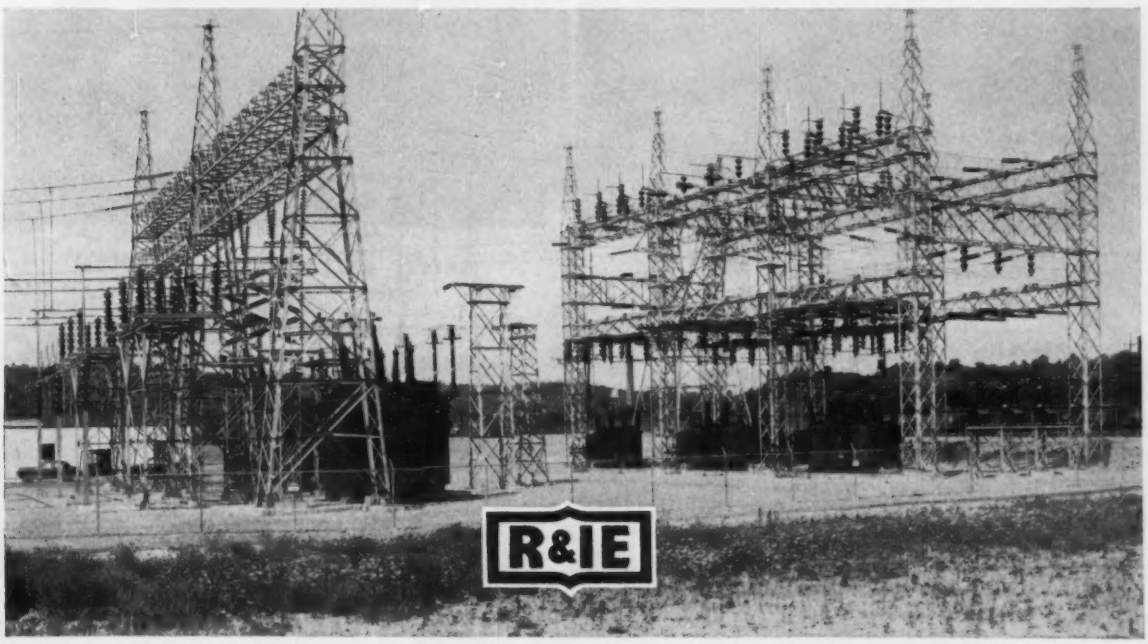


Power Class Automatic Circuit Reclosers

●

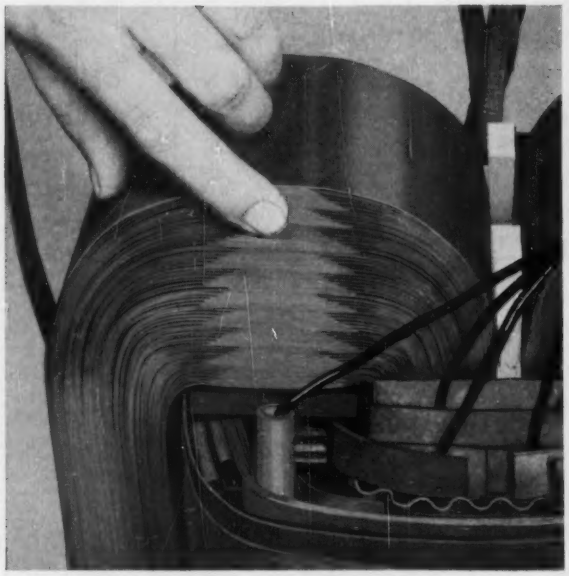
R&IE EQUIPMENT DIVISION

I-T-E CIRCUIT BREAKER CO., GREENSBURG, PA.



4 KUHLMAN TRANSFORMER FEATURES YOUR DISTRIBUTION SYSTEM'S

Kuhlman increases distribution system efficency by continuously improving basic transformer design. While new features have been added as they have been proved . . . major benefits spring from Kuhlman's concentration on engineering refinements in the basic components of transformer design . . . the core, coil, construction and insulation. Your study of the features illustrated below will show what we mean. Why not check your local Kuhlman representative on *all the features* that make Kuhlman your No. 1 transformer buy.



***FEATURE*—BENT IRON CORE:**
Lapped construction eliminates air gaps, offers low flux density in the lapped areas.

RESULT:
Lower exciting current; less load on the distribution system; reduced operational costs.

***FEATURE*—BALANCED COIL:**
Compact windings of low temperature rise are balanced with ample cooling ducts for oil circulating and rapid heat transfer.

RESULT:
Greater short-time overloading capacity; longer, more reliable transformer life.

HOUSEPOWER HELPS YOU LIVE BETTER ELECTRICALLY
LIVE BETTER ELECTRICALLY

KUHLMAN

BAY CITY, MICHIGAN • CRYSTAL SPRINGS,

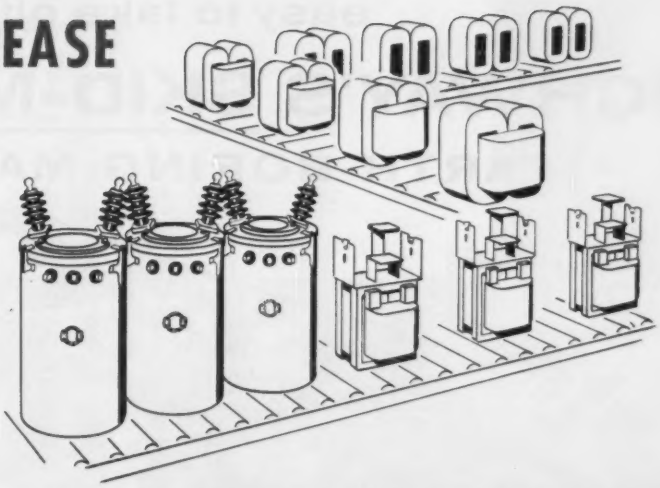
THAT CAN INCREASE EFFICIENCY...

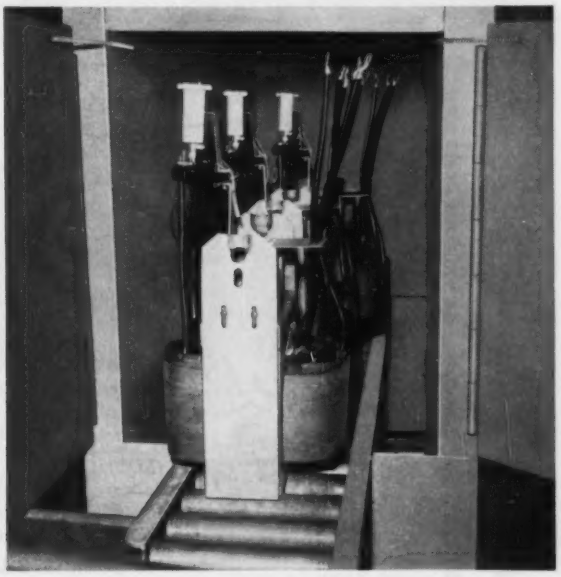
★ LOW EXCITING CURRENT

★ CAPACITY TO SPARE

★ RIGID CONSTRUCTION

★ LOW POWER FACTOR





***FEATURE*—RIGID CONSTRUCTION:**

Core and coil assembly held firmly in place by core clamp; additional blocking for coil support; leads held rigid by lead guides.

RESULT:

Greater protection against short-circuit stresses and damage from handling and shipping. Longer trouble-free operating life.

***FEATURE*—POWER FACTOR CONTROL:**

Moisture eliminated by controlled processing; coils pre-dried before varnishing . . . coils varnished and baked . . . core and coil assembly dried on the line (as shown above) . . . unit is tanked and put under oil while still above room temperature . . . vacuum removal of all entrapped air.

RESULT:

Low power factor indicating high insulation strength and assuring long service life.

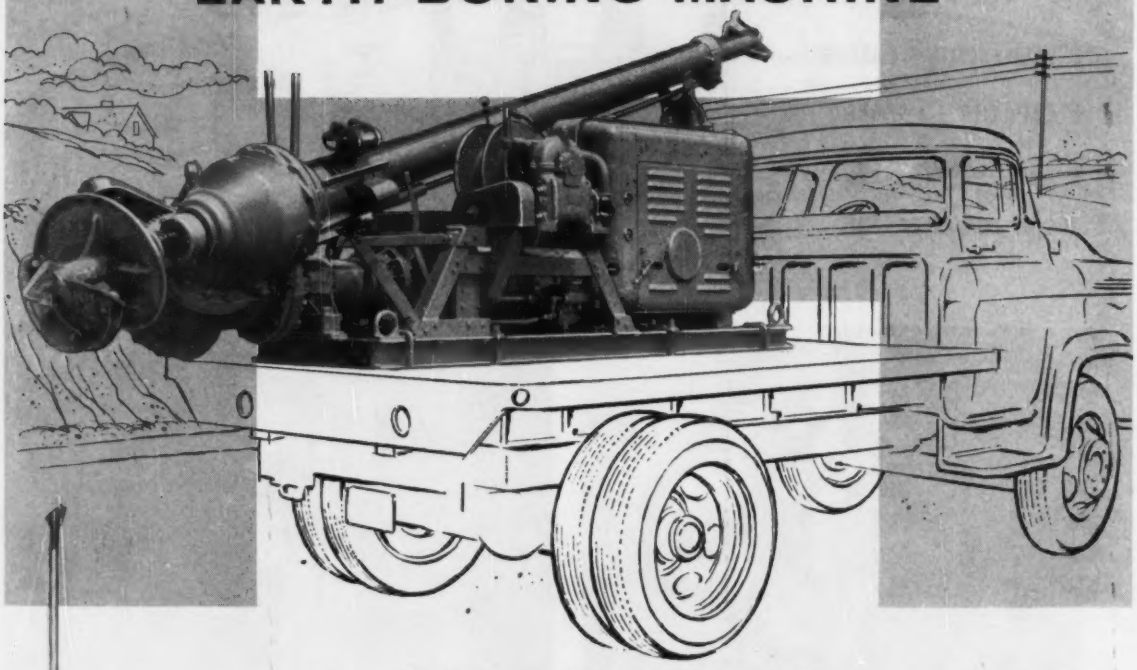
ELECTRIC COMPANY

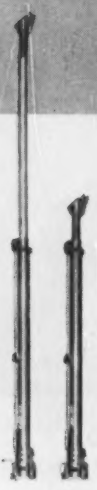
MISSISSIPPI • SALINAS, CALIFORNIA

572

easy to put on...
easy to take off!

HIGHWAY'S SKID-MOUNTED
EARTH-BORING MACHINE





Exclusive!

Highway Telescoping Derrick

The telescoping derrick (3500-lb. capacity) can be extended 28 ft. 6"—derrick retracts for convenience of operation. Available as optional equipment on the Model "HC" and "HCMS" machines.

Digs the Hole and Sets the Pole in any Soil!

Here's a heavy-duty earth-boring machine with mounting versatility seldom found in such a rugged unit. Highway's HCMS skid-mounted earth borer can be truck-mounted, tractor-mounted, or mounted on almost any type of conveyance.

ECONOMY OF OPERATION — The versatile skid-mounted unit eliminates costly mounting charges. The entire machine can be quickly mounted or removed from the platform, allowing the vehicle to be used for other work.

A COMPLETE UNIT — the HCMS is integrally assembled with clutch, transmission and a long-life Continental Red Seal 226-cubic-inch engine. It digs holes from 9" to 36" in diameter in any soil condition — even in rock when equipped with a special auger.

DIGS AT ANY ANGLE UP TO 90° at right angles to the vehicle and up to 60° in line with it. Leveling mechanisms permit quick adjustment to dig vertical holes regardless of vehicle position. Your choice of platform or ground control allows full visibility and automatic safety.

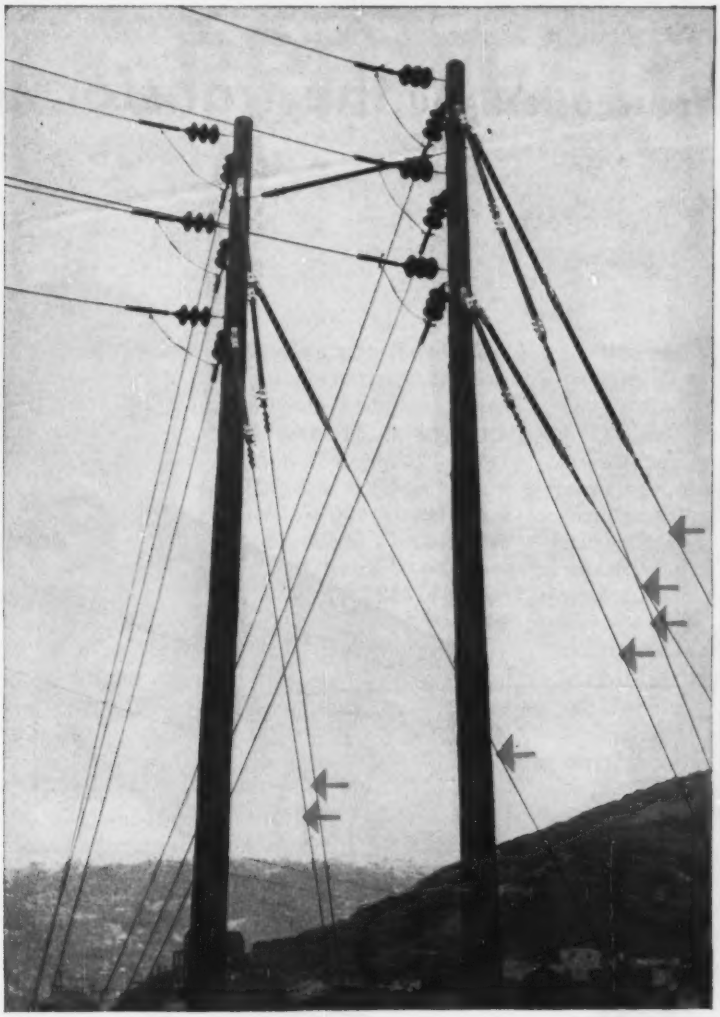
SETS BIG POLES with your choice of integral winch and derrick or completely automatic telescoping derrick.

HIGHWAY

A Division of the Equipment Department, Marmon-Chapman & Scott Corp.

UTILITY DIVISION
HIGHWAY TRAILER COMPANY
Headquarters: EDGERTON, WISCONSIN

Manufacturers of Public Utility Bodies • Earth-Boring Machines • Pole and Cable Reel Trailers • Winches • Power Take-Offs • Service Accessories • Commercial Trailers • Trailerized Tanks and Dry Bulk Haulers
SALES AND SERVICE IN PRINCIPAL CITIES



These "new" Copperweld Guys are **30 years old** —*and* ***still going strong!***

Installed 30 years ago, these Copperweld* Guys are as "new," safe, and strong today as the day they were put up—still good for many more years of dependable, maintenance-free service.

Unusual? Not for Copperweld. When it's up, it's up to stay—an advantage of vital importance to every operator of overhead lines.

Non-rusting Copperweld Strand, with its permanent high strength, matches pole life—eliminates guy repair and replacement costs. And, when you consider that the price of the guy strand is such a small part of the total installation cost, it's false economy to use anything but Copperweld—the best guy strand available.

**Trade Mark*

non-rusting **Copperweld** TRADE MARK **GUY STRAND**

COPPERWELD STEEL COMPANY
WIRE AND CABLE DIVISION *Glassport, Pa.*
For Export: COPPERWELD STEEL INTERNATIONAL COMPANY, New York

***The Best** in Terms of Safety and Service!*

Only Westinghouse offers you **the transformer**

with a PRE-TESTED LIFE!

Here's a transformer that can actually help you program your equipment investment thirty years from now—today. How? Through a revolutionary new concept of accelerated life testing, Westinghouse has pre-tested transformer life. Thirty years of equipment service has been telescoped into three.

Entire transformers from the production line have been put through literally thousands of cycles of overload up to 450% of rating, under closely simulated service conditions. Masses of data used to set up this unique program of testing include representative ambients as well as abnormal currents and voltages such as lightning and switching surges. Here is exhaustive evidence of durability of materials, uniform strength of windings, capability of whole insulation systems. Here is foolproof evidence of the soundness of Westinghouse transformer design . . . evidence that test-tube testing can't match.

The new Westinghouse Type S and CSP® transformer developments are based on the soundness of this design. Overload capability for all transformers has now been increased 20%, *without sacrifice in normal service life.* You get transformer capability tied more closely to modern load demands . . . a greater margin for peak. For the CSP transformer . . . fewer trip-outs, more time to make change-outs.

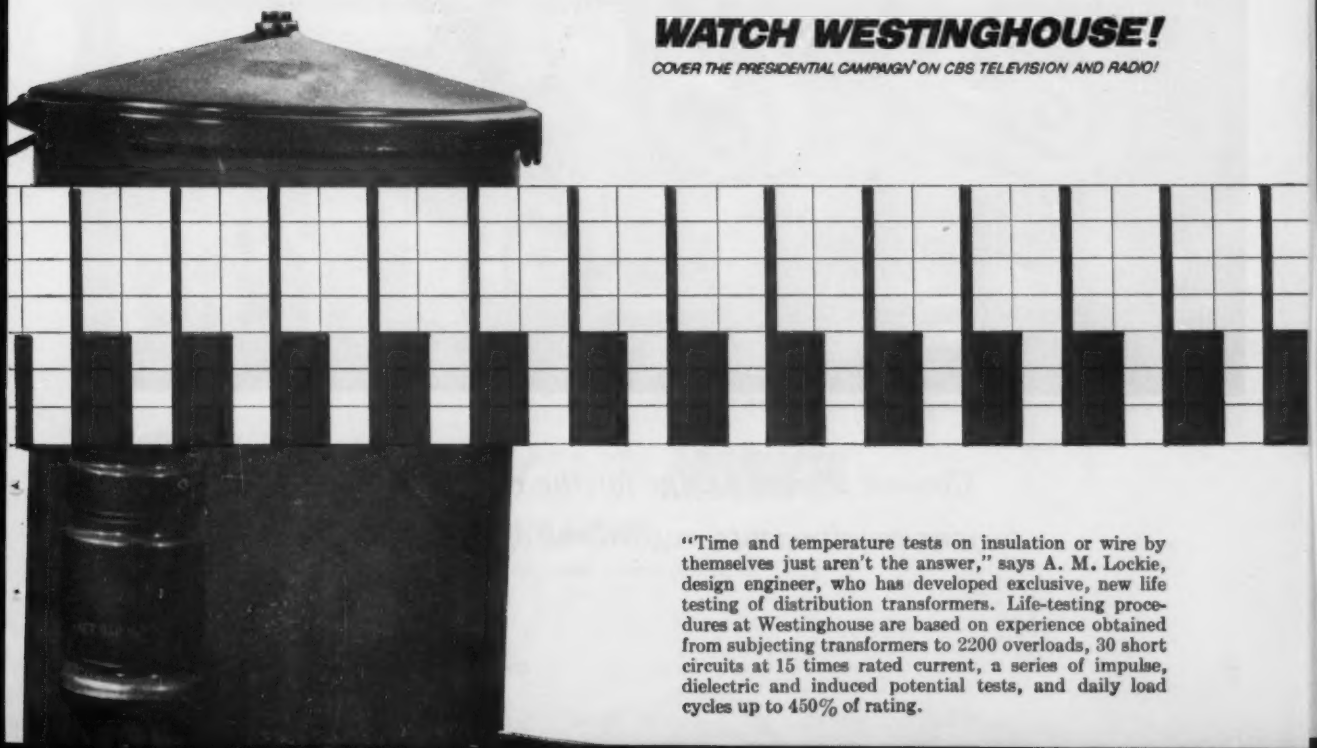
Are these transformers at these ratings proved on the line? 10,412 uprated Westinghouse transformers have operated successfully up to three years throughout the systems of utilities in New York, Missouri, Texas.

So here is double proof of performance of Westinghouse transformers. You don't have to gamble.

See your Westinghouse sales engineer, or write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-70782

WATCH WESTINGHOUSE!

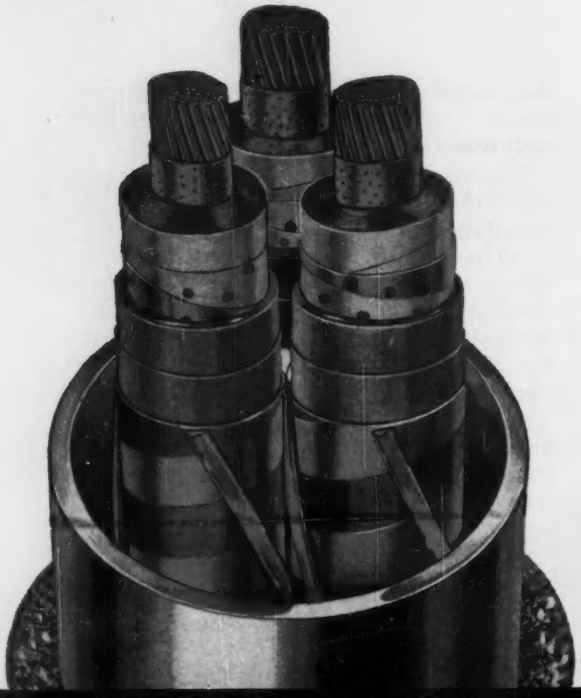
COVER THE PRESIDENTIAL CAMPAIGN ON CBS TELEVISION AND RADIO!



"Time and temperature tests on insulation or wire by themselves just aren't the answer," says A. M. Lockie, design engineer, who has developed exclusive, new life testing of distribution transformers. Life-testing procedures at Westinghouse are based on experience obtained from subjecting transformers to 2200 overloads, 30 short circuits at 15 times rated current, a series of impulse, dielectric and induced potential tests, and daily load cycles up to 450% of rating.

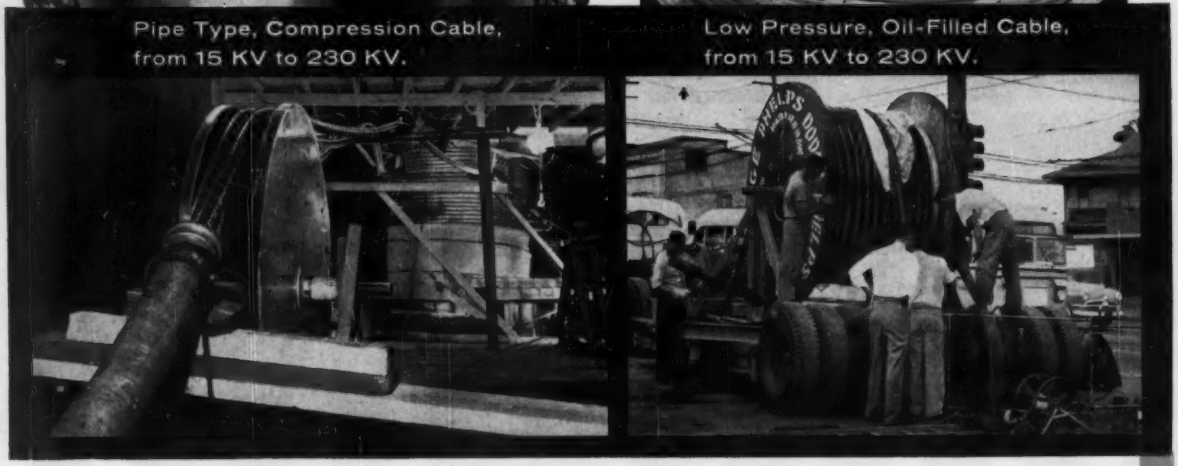
Phelps Dodge

WIDEST RANGE OF HIGH



Pipe Type, Compression Cable, from 15 KV to 230 KV.

Low Pressure, Oil-Filled Cable, from 15 KV to 230 KV.

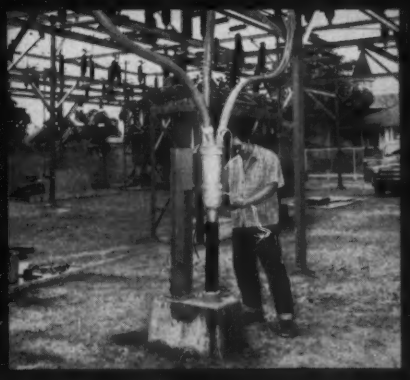


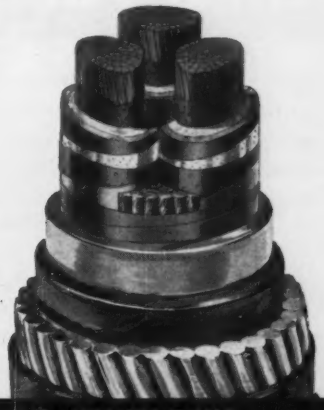
Consult Phelps Dodge for the correct answer to your requirements, regardless of voltage or type!

offers Industry's VOLTAGE POWER CABLE!

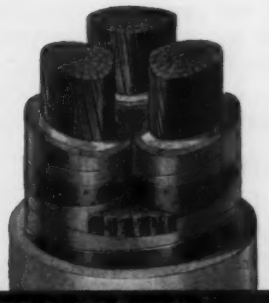
Only Phelps Dodge has manufacturing experience and operational "know how" with the entire range of high voltage cables which includes: oil compression, gas compression, high pressure oil, high pressure gas, pipe type cables; medium pressure gas, low pressure oil-filled, low pressure gas, submarine and solid type cables.

Low Pressure, Gas-Filled Cable, from 15 KV to 44 KV.

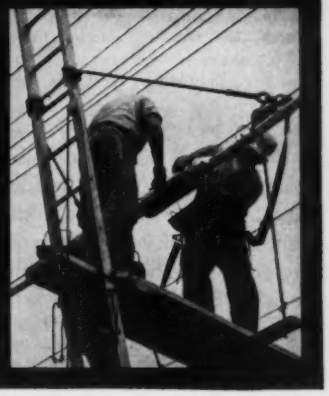




Submarine Cable, from 15* KV to 35 KV.



Solid Type Cable, from 15* KV to 69 KV.



*Lower voltage cables in this class also available.

PHELPS DODGE COPPER PRODUCTS CORPORATION

300 PARK AVENUE, NEW YORK 22, N. Y.

BEST BURNER BIG BOILERS

...C-E Tilting, Tangential Burner

Nearly 450 C-E Boilers with an aggregate capacity of well over 200-million pounds of steam per hour are now in service proving the advantages of firing with C-E Tangential Burners. And another 125 units are under construction or on order. The more important of these advantages are:

BETTER COMBUSTION

Tangential firing is fundamentally the best method of firing any fuel – coal, oil or gas – particularly in big furnaces. Here's why:

1. The extreme turbulence created by impinging flame streams of adjacent burners assures the most effective mixing of all the air with all of the fuel to produce the most rapid and complete combustion.

2. The swirling, rotating travel of combustion gases fills the furnace cross-section and utilizes the heat absorbing wall surfaces most effectively.

SUPERHEAT CONTROL

Virtually all tangential burners in large C-E utility boilers are of the vertically adjustable (tilting) design. This feature provides, in addition to the exceptional combustion efficiency inherent in tangential firing, a degree of superheat temperature control which cannot be achieved with any other firing method. Here's how:

1. If steam temperature goes too high, the C-E Tilting, Tangential Burner nozzles *automatically* tilt downward. More furnace wall surface becomes effective. Gas temperature to superheater surface is lowered. *Steam temperature comes down.*

2. Conversely, if steam temperature drops below that efficient for the turbine, nozzles tilt upward, sending hotter gases to the superheater. *Steam temperature goes up* — automatically.

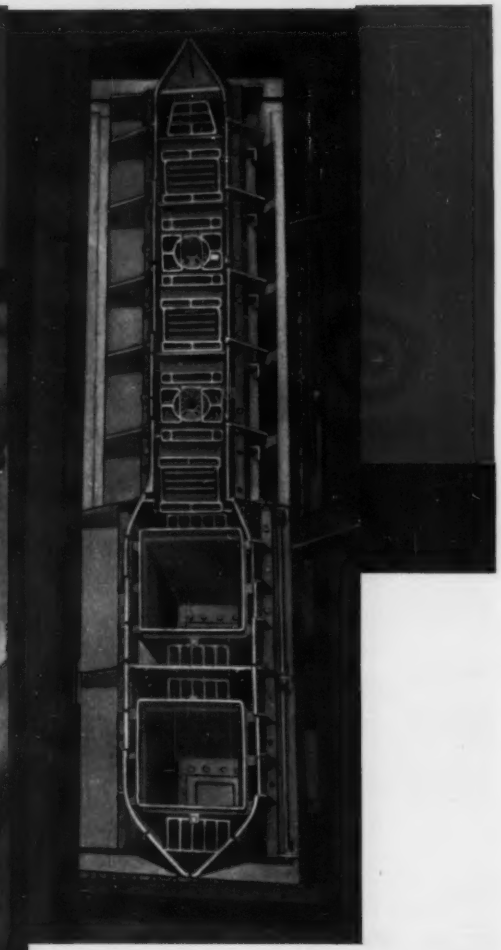
As a result, the minimum gas temperature necessary to assure proper superheat is maintained. There is little need for desuperheating . . . minimum use of spray water . . . less chance of fouling turbine blades. Turbine availability is higher . . . efficiency is maintained.

In the most important areas of performance, therefore, the tangentially fired unit has established itself *in service* over a period of many years as the best method of firing for big boilers. More recently it met similar success in smaller oil and gas fired units for capacities as low as 50,000 lbs of steam per hour.

A new catalog, PC 8, gives many more details. May we send you a copy?

C-E Tangential Burners are now shop assembled with adjacent furnace tubes in place. The illustrations below and at left clearly indicate the resulting advantages in transportation, handling and installation.

FOR



▲ **The versatility of the tangential burner is well illustrated by this rather special design, made for a wide variety of fuels. This burner has nozzles for coal, oil, coke oven gas and — at the bottom — blast furnace gas. The latter is stationary—the rest are adjustable.**

◀ **This view of the firing floor of a large tangentially fired C-E utility boiler shows the clean-cut, uncluttered appearance which is typical of units of this type.**

COMBUSTION ENGINEERING

B-961

Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y.

STEAM GENERATING UNITS • NUCLEAR REACTORS • PAPER MILL EQUIPMENT • PULVERIZERS • FLASH DRYING SYSTEMS • PRESSURE VESSELS
HOME HEATING AND COOLING UNITS • DOMESTIC WATER HEATERS • SOIL PIPE

Wagner TRANSFORMERS . . . the choice of leaders in industry

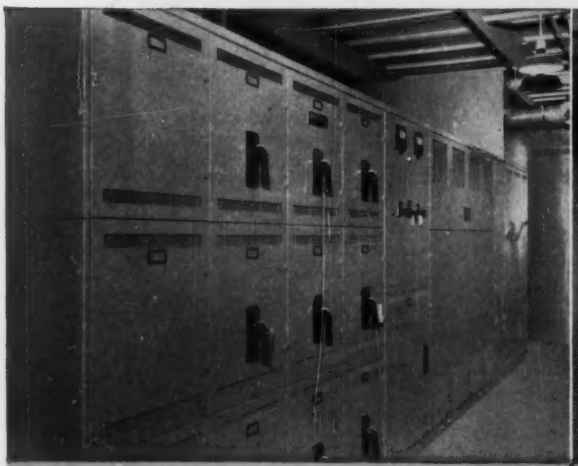
Wagner Unit Substation Transformers supply

At IBM's new Kingston Military Products Division plant at Kingston, New York, electricity and automation work together to increase output per manhour and to increase output per unit of plant area. The factory itself is the latest in modern manufacturing plant design and utilizes the modern load center scheme of in-plant electrical distribution. This method of secondary distribution brings power at high primary voltages close to the load to reduce voltage drop and conductor losses.

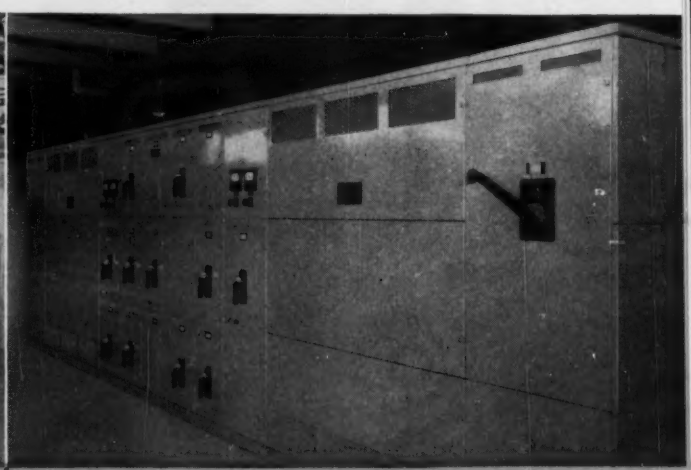
The unit substations in this plant are equipped with Wagner dry-type Transformers.

Wagner pioneered in the development of dry-type load center transformers, and the Wagner design is known for its great mechanical strength and electrical stamina. Wagner dry-type Transformers are carefully engineered to meet heavy industrial demands —built to stand up under rigorous twenty-four hour a day production schedules.

Wagner unit substation transformers can answer your power needs just as they do at IBM. Choose Wagner for your next load-center installation. Consult the nearest of our 32 branch offices or write for Bulletins TU-205 and TU-214. They give full information on Wagner Unit Substation Transformers for industrial power distribution systems.



This 1000 kva Unit Substation at IBM's Kingston plant is equipped with a Wagner dry-type load center transformer to deliver 216Y/125 volt three phase power to large machines and equipment.

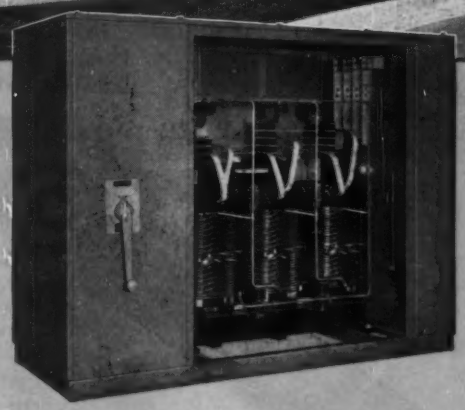


IBM uses this 1000 kva double-ended Wagner-equipped unit substation to supply 216Y/125 three phase power, for lighting and small power loads.

There's a Wagner Substation Transformer
PREDESIGNED **to meet your load-center needs**

Wagner Unit Substation Transformers are *"Predesigned"*. They are built in standard ratings which are coordinated with the specifications of unit substation builders. This completely eliminates individual job engineering—saves time—reduces costs. You get a proven design in a completely assembled and tested transformer —and get quick delivery.

Why not check up now on the adequacy of your transformers? If you find that new units or a new load center distribution system is in order—Wagner can supply you with substation transformers *predesigned* to meet your requirements.



Wagner dry-type transformers for power distribution are available in single-phase, 1 through 500 kva; and 3-phase, 3 through 2000 kva ratings.

Wagner Electric Corporation
EST. 1891

WAGNER ELECTRIC CORPORATION
6456 Plymouth Ave. • St. Louis 14, Mo., U. S. A.

T56-10

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS — AIR AND HYDRAULIC

BRANCHES IN 32 PRINCIPAL CITIES

For top value . . . in any type . . . get JENKINS

Gold Seal Tape

FRICTION · RUBBER · PLASTIC

BEST BUY FOR PLANT SUPPLY

All types of **GOLD SEAL TAPE** — Friction, Rubber, Plastic — are packed in 10-roll cartons as well as single rolls. Every roll cellophane-protected, stays fresh. Jenkins Bros., Rubber Division, 100 Park Ave., New York 17.

DIAMOND SEAL
Friction and Rubber Tapes are also made by Jenkins Bros. to ASTM specifications.

Savannah Electric and Power Reports:

TROUBLE-FREE COMMUNICATIONS FOR FOUR YEARS WITH GENERAL ELECTRIC TWO-WAY RADIO

For the past four years, the Savannah Electric and Power Company has depended upon trouble-free G-E two-way radio to coordinate maintenance, transmission, and construction crews throughout a five-county, fifty-mile city radius.

General P. E. Seawright, Superintendent of Transmission and Distribution for Savannah Electric and Power, reports his organization has never experienced a serious break in two-way radio communications, during four years of operation. He credits General Electric's dependable equipment, teamed with a maintenance program provided by the local General Electric Authorized Service Station, for assuring his firm of full 24-hour radio services.

Radio Cuts Service Loss Time

Seventeen mobile units in the fleet of service and supervisory vehicles are coordinated by radio from the office of General Seawright, in the Savannah office.

General Seawright credits the G-E two-way radio system for speedy assists in the restoration of service in emergencies. This is a vital factor to the thousands of homes and commercial installations over 1000 miles of line.

New Progress Line Radio

General Electric's new Progress Line radio provides full chassis, interchangeability, plug-in chassis, and new 6600 series tubes, specially designed and tested for radio communication circuits.

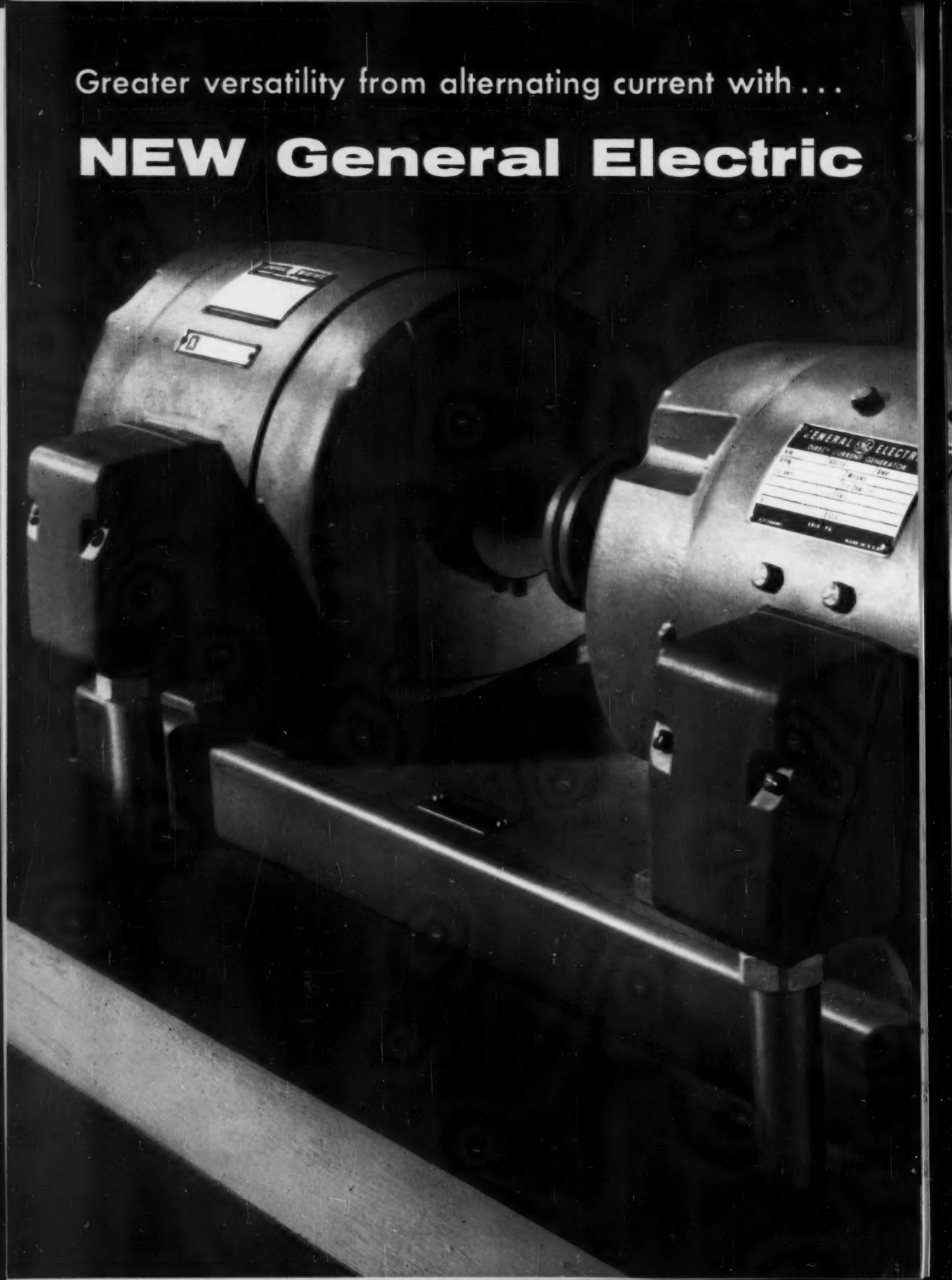
Your Communications Counselor can give you full details. Call him in, or, write: *General Electric Co., Communication Equipment, Section X19106-15, Electronics Park, Syracuse, N. Y.* In Canada, write: *C.G.E. Electronics, 830 Lansdowne Avenue, Toronto.*

Progress Is Our Most Important Product

GENERAL ELECTRIC

Greater versatility from alternating current with . . .

NEW General Electric



D-c Power Source

KINAMATIC* — — — a new standard in direct-current generators and motor-generator sets—designed to give industry d-c power from alternating current.

Today, progressive manufacturers are faced with the problem of boosting factory output and beating rising production costs. Where production processes involve adjustable-speed, tough duty cycles, frequent reversals or speed matching, many have already applied the performance advantages of d-c drives. To help further boost production and reduce automation costs, completely new sources of constant and adjustable-voltage d-c power are now available—General Electric d-c Kinamatic generators and m-g sets, ¾–100 KW.

More Power Per Dollar—D-c Kinamatic generators pack more power per frame size than any previously designed General Electric generator. Nine new kilowatt ratings more closely match both the power requirements of standard d-c drive motors and the power output of standard prime-moving a-c motors. This new matching gives a more efficient, more compact adjustable-voltage drive at lower cost.

And a Lot More—A d-c Kinamatic generator or motor-generator set can give much more than savings on initial automation costs. They provide the flexibility and reliability demanded of all machines in automated systems, and supply the power versatility required for close control and split-second timing of processes essential to higher industrial productivity. For more information on the d-c Kinamatic generators and m-g sets, please contact your nearest G-E Apparatus Sales Representative. Or, if you prefer, we will send you a copy of GEA-6461. *Direct Current Motor and Generator Department, General Electric Company, Erie, Pennsylvania.* 813-6

* Trademark of General Electric Company

Progress Is Our Most Important Product

GENERAL ELECTRIC

General Electric's new Luminaire Photometer "X-rays the heart" of your street lighting system

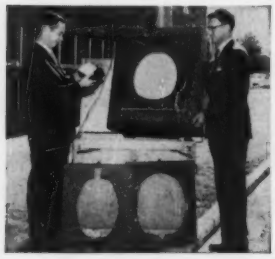
Accurately indicates Luminaire's light output... yet weighs less than a case of pop!

Now, with General Electric's new Luminaire Photometer, you can quickly and accurately compare the light output from street lighting luminaires in actual service—particularly those using mercury lamps. You gain vital information that helps you set up an economical, money-saving schedule for group relamping and luminaire cleaning. The G-E Luminaire Photometer is light (it weighs only 25 pounds), and it performs equally well day or night!

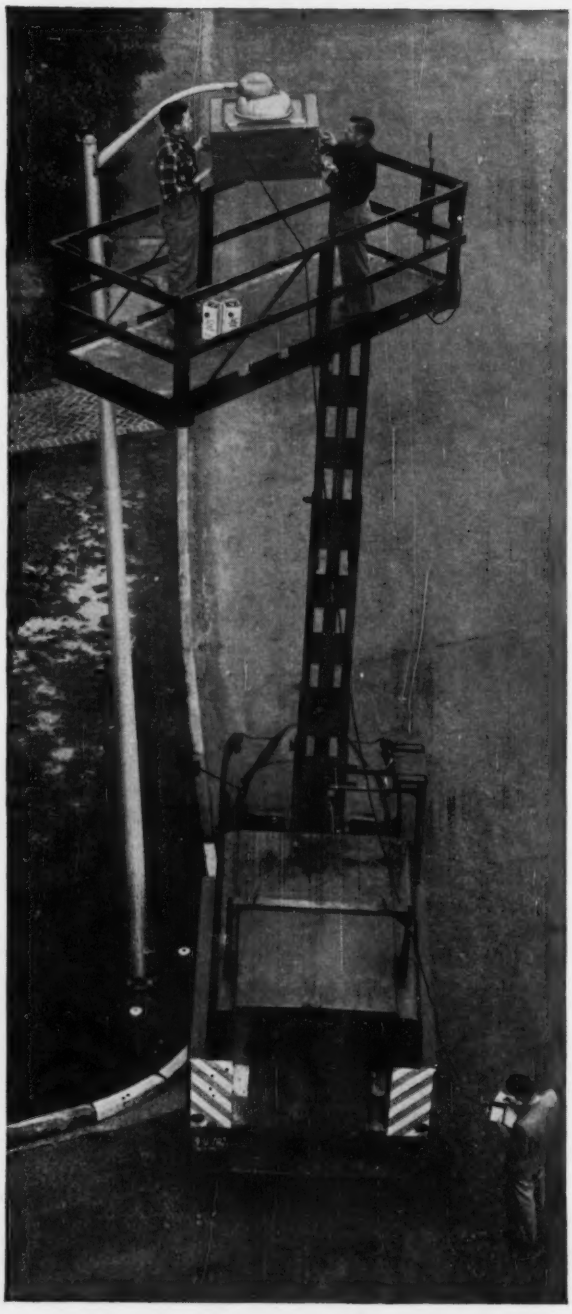
Just select the correct luminaire template and fasten it into the top of the photometer. Hold the photometer snugly against the luminaire. An operator on the ground, jots down the exact readings using a microammeter connected to light cells with a 40 ft. cord. Quick comparison of the readings with a standard lamp and luminaire will tell you which lamps may be low in light output . . . and just how fast each luminaire is losing light output due to dirt and dust.

For more information on the General Electric Luminaire Photometer, and the complete story on how it can help you, call your nearby General Electric Large Lamp Sales District—or write: General Electric, Large Lamp Dept. EW-10, Nela Park, Cleveland 12, Ohio.

To be sure you get lamps that measure up to their rated life and light output from the very start—and throughout their long period of service—specify General Electric Lamps, long respected for their uniformity and performance.



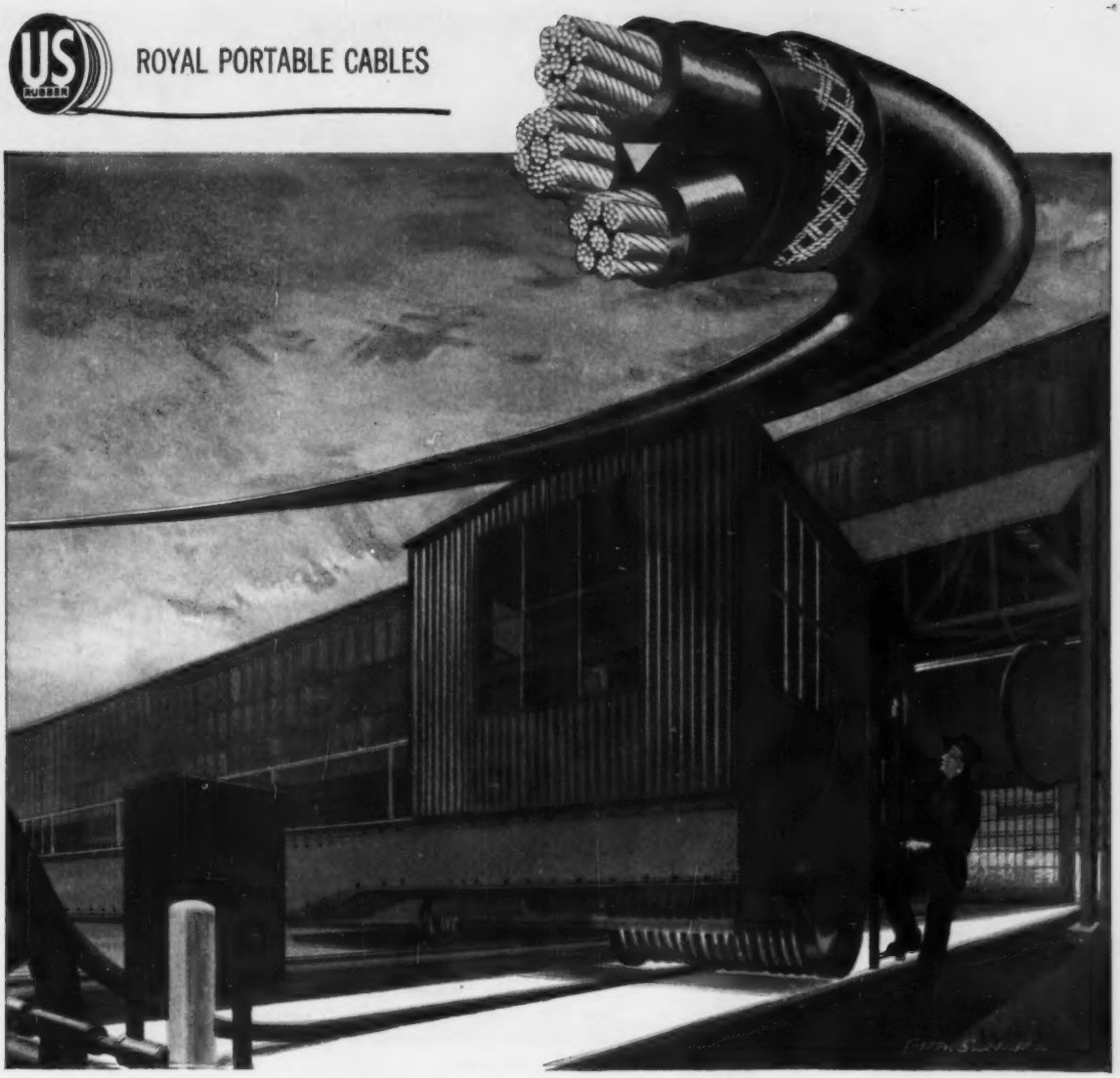
Photometer has special templates to fit the widely used types of luminaires. Photometer designers—G. H. Zaar (left) and D. A. Toenjes, of General Electric Large Lamp Dept.



Progress Is Our Most Important Product

GENERAL ELECTRIC

ROYAL PORTABLE CABLES



Still in Service after 29 years, 24 hours a day

and without a single splice, patch or power failure!

This amazing record was made by a 175-foot length of U. S. Royal portable cable installed in 1927 as a source of power for a traveling agitator in a cement plant*. This three-conductor cable has been fully exposed to weather for the entire 29 years. The agitator moves back and forth the length of the slurry basin, and the cable is simultaneously taken up and paid out by a revolving drum.

To "U. S." engineers, performances such as this are not too unusual. They stem, right at the start, from the determination of "U. S." technicians to produce only a *quality* product. This is possible because "U. S." is the only wire manufacturer to grow its own natural rubber, make its own synthetic rubber and its own plastics, assuring complete quality control with the help of unmatched research and manufacturing facilities.

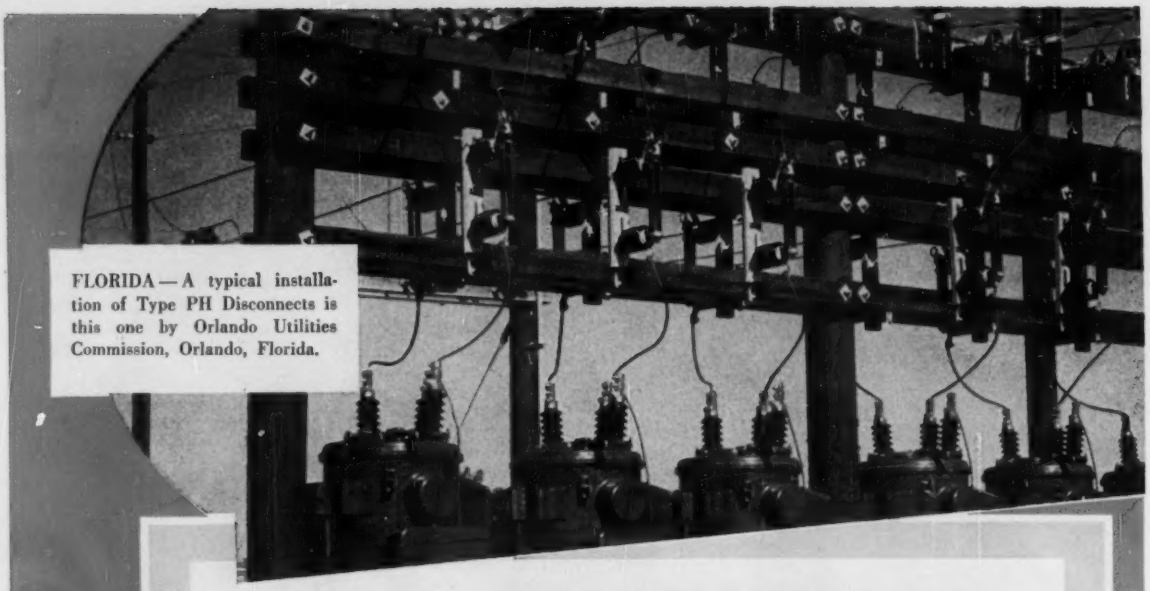
Call on the "U. S." wire and cable specialist to solve any wiring problem. Write United States Rubber Company, Rockefeller Center, New York 20, N. Y.

*Penn-Dixie Cement Corp., Tenn.

Watch NCAA football, Saturday afternoons, NBC-TV

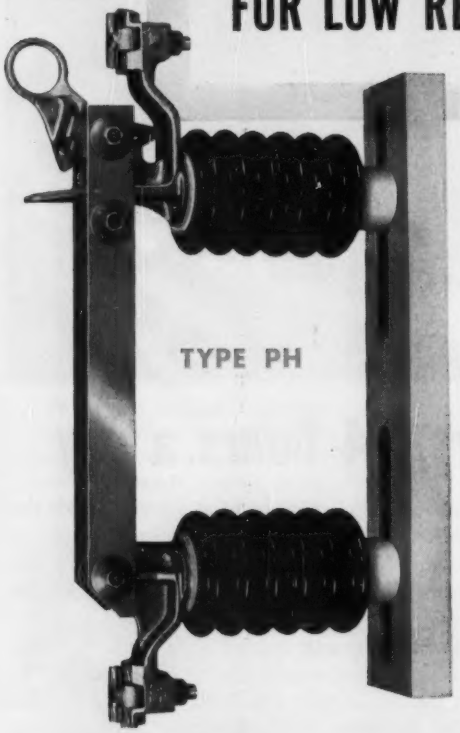
Electrical Wire & Cable Department

United States Rubber



FLORIDA — A typical installation of Type PH Disconnects is this one by Orlando Utilities Commission, Orlando, Florida.

A LOW-COST, HIGH-QUALITY DISCONNECT FOR LOW REVENUE DISTRIBUTION LINES



SOUTHERN STATES TYPE PH HAS MANY DESIGN EXTRAS

It is often difficult to justify expensive switches for isolating, by-passing, or disconnecting on low revenue distribution lines. Yet the mechanical features of such disconnects are highly desirable, as any operating man knows.

That is why Southern States designed its popular, low-priced Type PH Disconnect. Its cost is easily justified, and yet it has many design extras found on more expensive switching equipment. For instance:

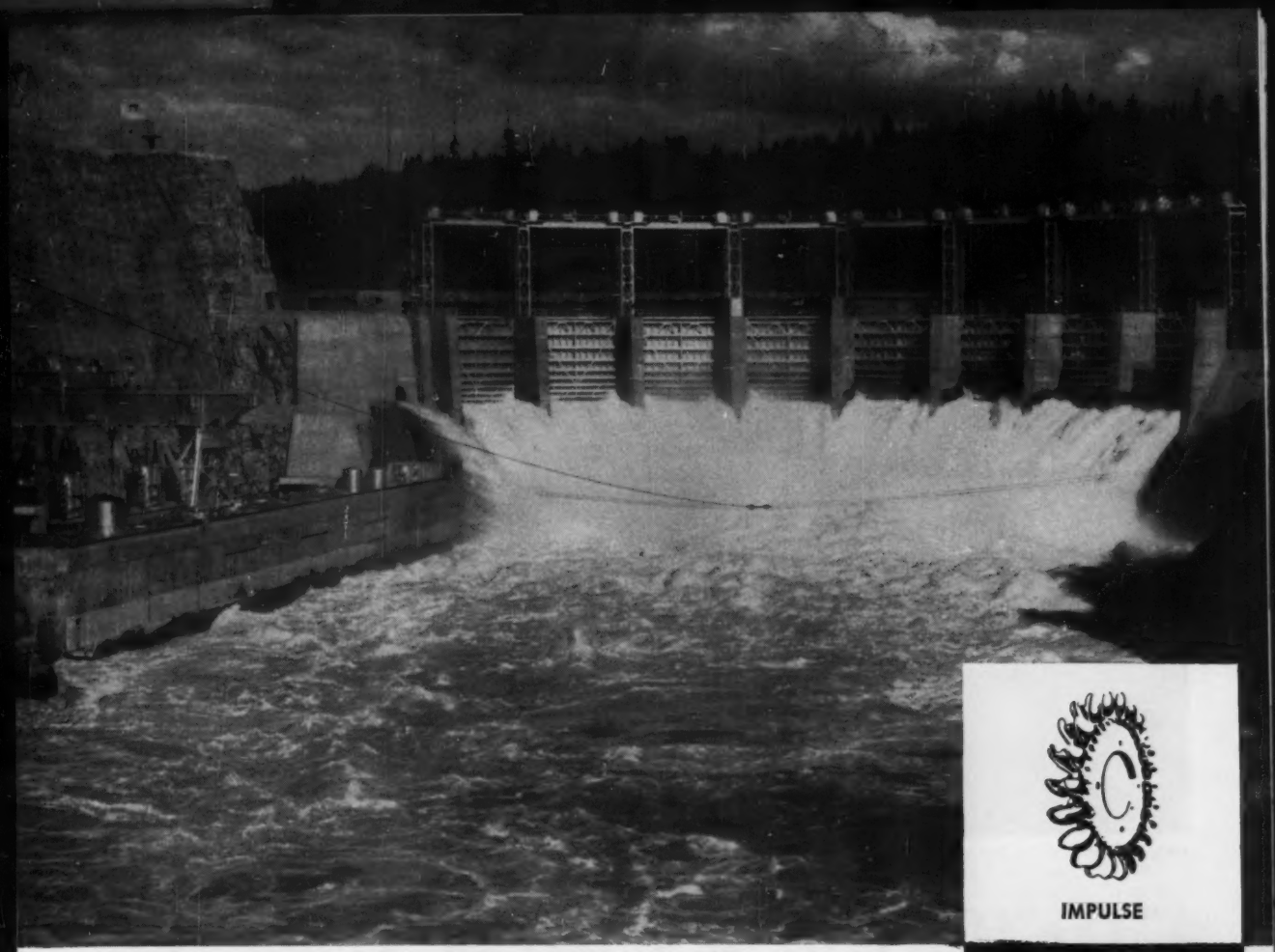
- **High-pressure line contacts**
- **Integral terminals**
- **Rugged parallel blade construction**
- **Blade pry-out action**
- **Positive blade latching**

This single throw, single pole, hookstick-operated switch designed for wood crossarm mounting, is answering the requirements for many utilities throughout the nation. You will find it profitable too. For full details, write for Bulletin 54 PH.

CHANNEL OR ROLLED FLANGE STEEL BASES ARE AVAILABLE.

SOUTHERN STATES EQUIPMENT CORP.
HAMPTON, GEORGIA

IN CANADA: Dominion Cutout Co., Ltd., Toronto



Hydroelectric plant of The Washington Water Power Company at Cabinet Gorge. Three BLH fixed blade propeller turbines and one BLH Kaplan turbine produce 282,000 hp here.

how BLH can help solve your turbine problems

Here are four ways we can help you:

- We have excellent hydraulic laboratories for testing scale models under simulated operating conditions. Laboratory tests assure proper design of turbines to meet your specific conditions.
- Eddystone and Pelton Divisions of BLH Corporation have been designing and building turbines since 1841. There's no substitute for experience, and our experience is all yours to command.
- We build all four basic turbines—Impulse, Kaplan, Francis and Propeller type. You can be sure that our recommendations are objective.
- We manufacture surge suppressors, valves, pumps, governors and other accessory equipment. You place all responsibility in one source of supply.

Would you like a copy of our 22-page catalog illustrating and describing our hydraulic power equipment and typical installations? Write to BLH Corporation, Philadelphia 42, Pennsylvania, or Dept. 5507, Pelton Division (BLH), 2929 Nineteenth Street, San Francisco 10, California.

BALDWIN BLH LIMA-HAMILTON

EDDYSTONE DIVISION
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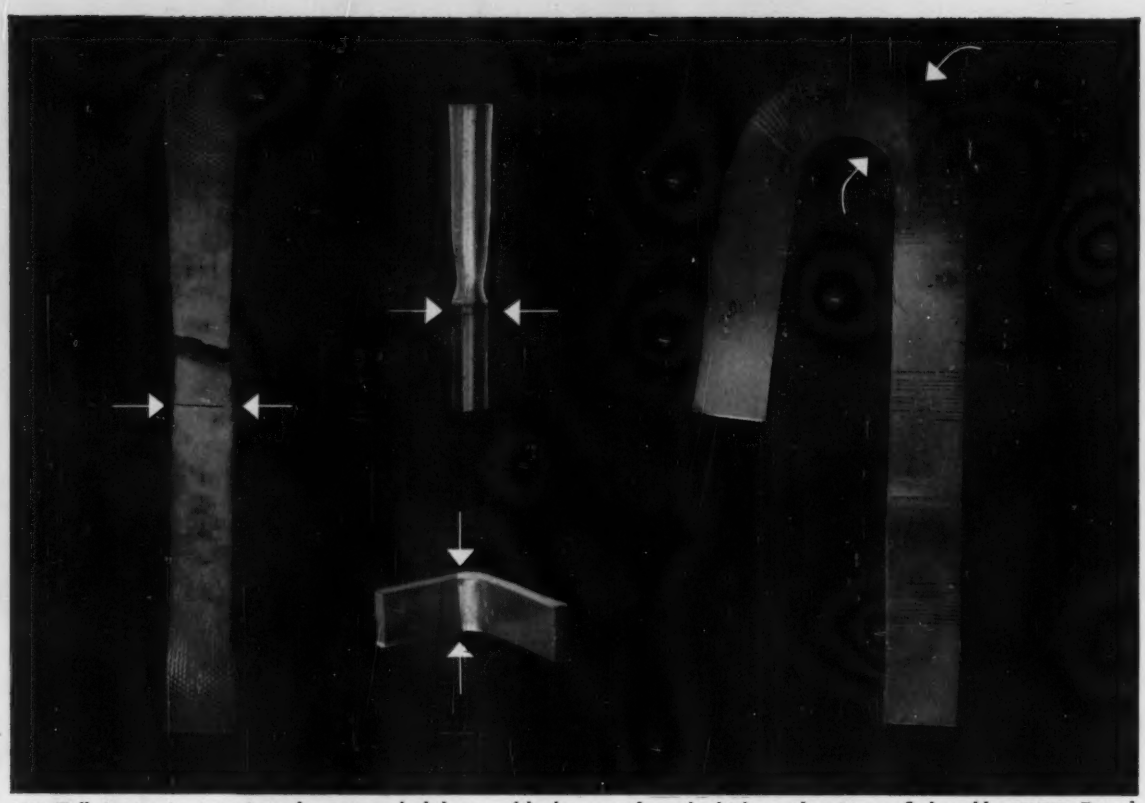


LEFT: Full-size tension test piece of copper necked down and broke away from the high-speed resistance flash welds. **CENTER:** Round (1.25" diam.) and rectangular (0.50" x 1.50") aluminum conductors resistance–flash-welded to copper. In the 90-degree bend test, fracture did not occur at the weld. In tension test, aluminum necked down, but the weld was unaffected. **RIGHT:** Test samples of copper (.344" x 2.25") bent edgewise at the welded joint, without fracture.

High-speed resistance Flash Welds offer New Freedom in design of Continuous Conductor Assemblies

After considerable experimentation and testing, Anaconda American Brass Ltd. in Canada is now joining conductors to form continuous assemblies for generator coils with high-speed resistance flash welds. A 400-KVA Thomson Synchromatic Flash Welder is used.

Proof of the strength of the welds is indicated by photos of the test pieces above.

The tension test piece, shown at the left, necked down and broke in the copper, away from the weld.

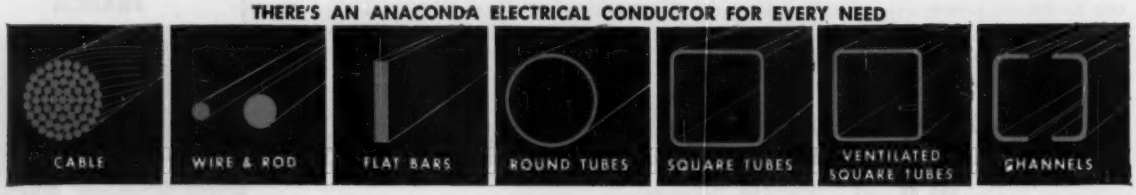
Size tested.....0.329" x 2.251", round corners
Maximum load.....22,900 lbs.
Ultimate tensile strength...31,200 lbs. per square inch
Elongation in 2 inches at fracture.....70 per cent
Elongation in 2 inches across the joint.....35 per cent

These high-speed resistance flash welds offer new freedom in the design of continuous conductor assemblies. Other methods of strong, ductile welding, braze-welding, and silver-alloy brazing may also be used to join Anaconda High Conductivity Copper Conductors in the shop or in field erection. Write for the new edition of Publication C-25, "Anaconda Copper for Electrical Conductors," and Publication B-13, "Anaconda Welding Rods." Write: Technical Department, The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario, Canada.

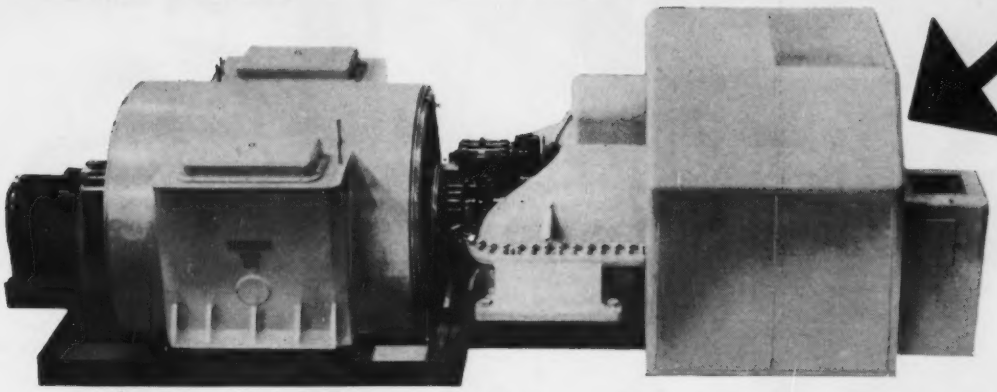
58103

ANACONDA® COPPER CONDUCTORS

THERE'S AN ANACONDA ELECTRICAL CONDUCTOR FOR EVERY NEED



a paying investment from the start



BROWN BOVERI TURBO-GENERATORS

you get ALL these DIVIDENDS

- Top Efficiency
- Thorough Dependability
- World-famous Quality
- Compact Design
- Long Life
- Minimum Maintenance

ALL this... and LOWER INITIAL COST, too!

BROWN BOVERI

A Brown Boveri Turbo-Generator pays off at the start in *low initial* cost. And, it continues to pay dividends with the substantial dollar savings made possible by power, *consistently delivered*, at low operating and maintenance costs.

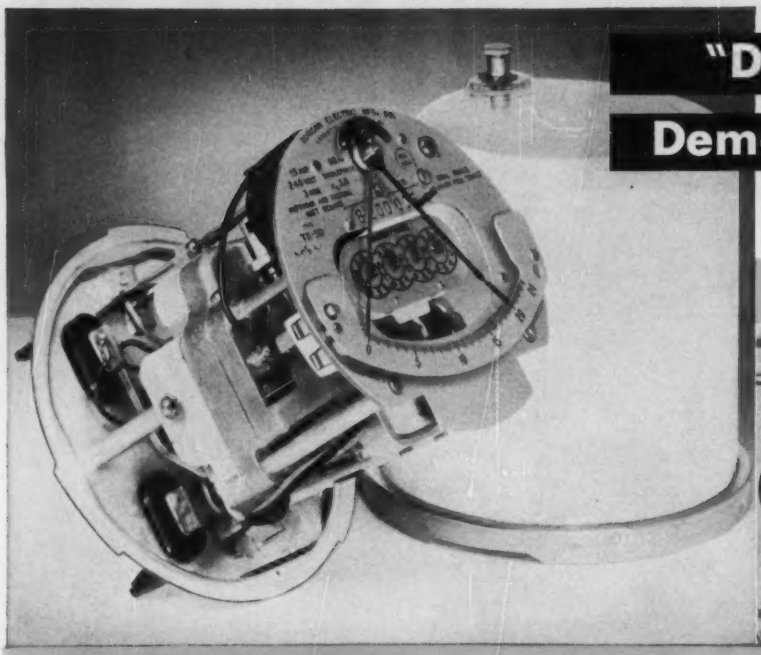
It will pay you to investigate Brown Boveri Turbo-Generators as all-'round paying investments.

WRITE FOR DATA!

BROWN BOVERI CORPORATION

19 RECTOR STREET • NEW YORK 6, N. Y.

Atlanta, Ga. • Birmingham, Ala. • Boston, Mass. • Buffalo, N. Y. • Butte, Mont. • Chicago, Ill. • Cleveland, O. • Denver, Colo. • Detroit, Mich. • Hamilton, O. • High Point, N. C. • Houston, Tex. • Jacksonville, Fla. • Kansas City, Mo. • Knoxville, Tenn. • Lewiston, Me. • Miami, Fla. • Minneapolis, Minn. • New Orleans, La. • New York, N. Y. • Pasadena, Cal. • Portland, Ore. • Roanoke, Va. • San Francisco, Cal. • Seattle, Wash. • Syracuse, N. Y. • Tucson, Ariz.



"Dual Range" Demand Metering

New Meter Offers Choice of Demand Scales

Duncan TK "Dual Range" Thermal Demand Meter

● The new Duncan Type TK Singlephase Thermal Demand Meter is actually *two meters in one*. With a choice of scale capacities, either 12 KW or 24 KW, the meter can be matched to the load being measured. This is made possible by a range switch which interlocks with the demand scaleplate so that the electrical circuit is always connected correctly for either scale used—*see illustrations at right*. This change of scales may be made in the field without re-calibrating the meter; although some companies may prefer to make a calibration check.

The meter illustrated above is the socket type TK-SD. The corresponding bottom-connected type is TK-AD. The TK meter has the same *thermal element* that has been used successfully for over four years in Duncan Type TH polyphase meters. This high torque element minimizes the effect of any friction—thus greatly reducing maintenance. Errors in reading the demand due to parallax are minimized by the Kelvin or raised scale—putting it on the same level with the maximum pointer.

The Duncan MK *watthour element* is incorporated in the design of the TK meter. This 15-ampere element has adequate capacity for accurately metering continuous loads up to 100 amperes. All other features of the MK line also apply—such as arc-resistant molded-insulation, Alnico V damping magnet, microset adjustments accessible from the front, and rigid construction throughout—all designed for easiest possible maintenance.

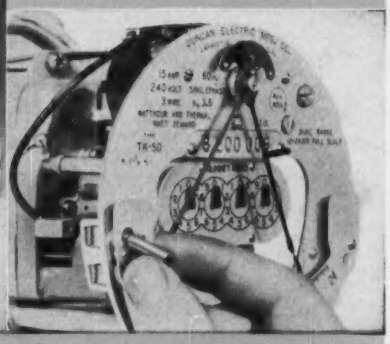
The dual range feature is also available in the Duncan singlephase 50-amp 240-volt 3-wire, 24/48 KW Type TF-SD meter for metering loads up to 200 amperes.

"Dual range" is a new concept in demand metering—one more feature of Duncan thermal meters—making possible low-cost demand measurement.

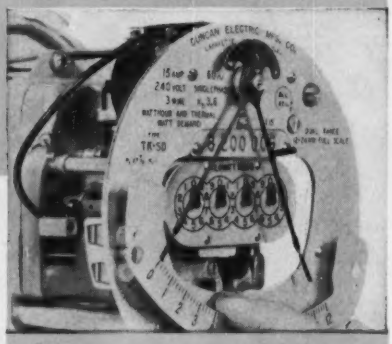
DUNCAN ELECTRIC MFG. CO.
Lafayette **Indiana**

(Advertisement)

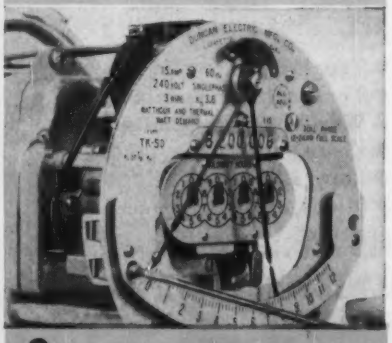
Changing Scale—



1. Remove three screws.



2. Turn scale over.



3. Replace screws. Note: One of the screws is a "switch contact" which is interlocked with a hole in the scaleplate to match scale being used.

"Magic Touch"

Lights burn and wheels turn when the magic of electricity surges through industry's life line of high voltage cable. Long, intensive testing has proved beyond question that Simplex ANHYDREX XX insulated cable possesses the stability and resistance that assure long, trouble-free service in all environments. Its amazing resistance to ozone and other oxidizing agents make Simplex ANHYDREX XX the logical choice for your high voltage applications. For complete technical data write for Booklet 1023.

SIMPLEX WIRE & CABLE CO.,
79 Sidney Street, Cambridge 39, Mass.

LIVE BETTER ELECTRICALLY

Simplex

ANHYDREX XX

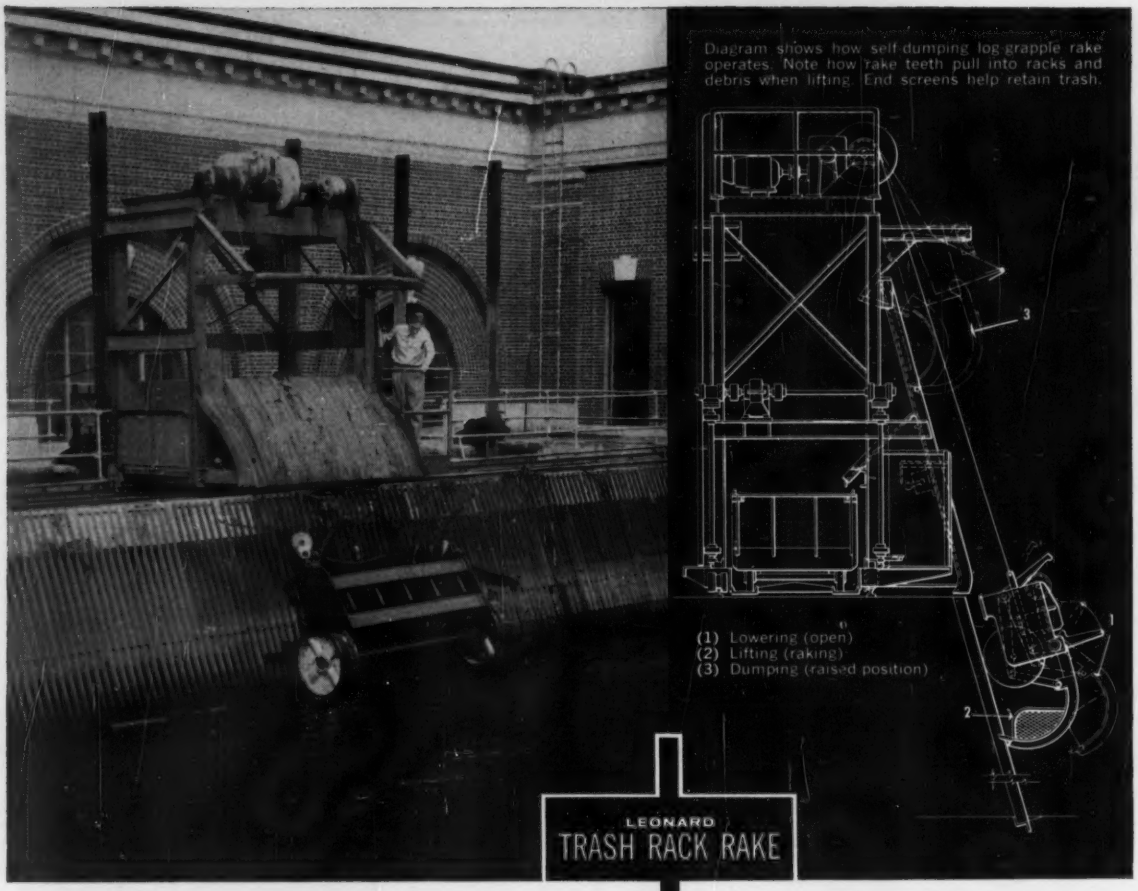


Diagram shows how self-dumping log-grapple rake operates. Note how rake teeth pull into racks and debris when lifting. End screens help retain trash.
(1) Lowering (open)
(2) Lifting (raking)
(3) Dumping (raised position)
1
2
3
LEONARD
TRASH RACK RAKE

New 8-foot, self-dumping SMS rake at Niagara Mohawk Power Corporation's Black River Station is one of five recently installed by this company.

Two New Self-Dumping SMS Trash Rake Designs CUT CLEANING TIME AND LABOR

Now SMS offers you two improved Leonard trash rack rakes, both regular and log-grapple types. These self-dumping rake designs make operation easier and quicker, permit you to clean a greater area faster. Both new rake types are now available as additions to the SMS line of standard rake designs.

SMS Leonard rakes operate directly on trash rack bars . . . ride down over stubborn obstructions and work them loose. Such freedom of movement assures fast, easy cleaning. Initial costs are low because the width of SMS rakes can be kept to the minimum required for handling for trash and the expense of guides attached to racks, or embedded in piers is eliminated. These rakes are of simple and rugged construction, designed for outdoor service and require minimum maintenance.

To get full information on Leonard trash rakes, or on other SMS accessories and hydraulic turbines, write to S. Morgan Smith Co., York, Penna. For Leonard rakes, request Bulletin 158.

SMS

S. MORGAN SMITH

AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

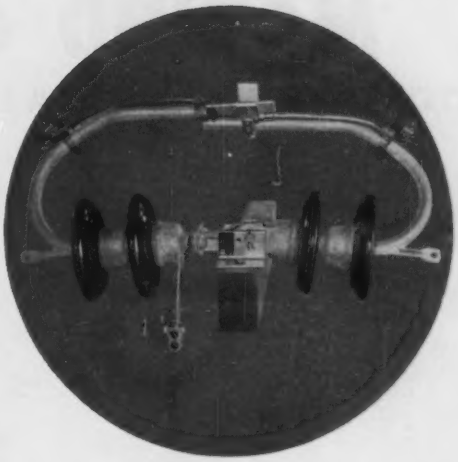
HYDRAULIC TURBINES · GATES & HOISTS · TRASH RAKES · PUMPS · LIQUID HEATERS

HYDRODYNAMICS

ROTOVALVES · FREE DISCHARGE VALVES · BALL VALVES · CONTROLLABLE-PITCH SHIP PROPELLERS · BUTTERFLY VALVES

Licensees: The Harland Engineering Company, Ltd., Alloa, Scotland • Tokyo Shibaura Electric Co., Ltd., Japan

You can install KPF switches more quickly, at less cost, than any comparable switch. Just bore six holes in a single cross arm, mount, and connect. No precision requirements, no temperamental mechanism to bind, freeze, malfunction or need lubrication. Just simple, cleanly designed parts, arranged in a rugged, foolproof manner for trouble-free operation. The economy and dependability of KPF switches has been proved on major utility systems for almost 50 years.



install in the air — or on the ground

Mount phase units individually to pre-installed cross arm on the pole top.

Assemble complete switch on the cross arm before arm is installed on pole.

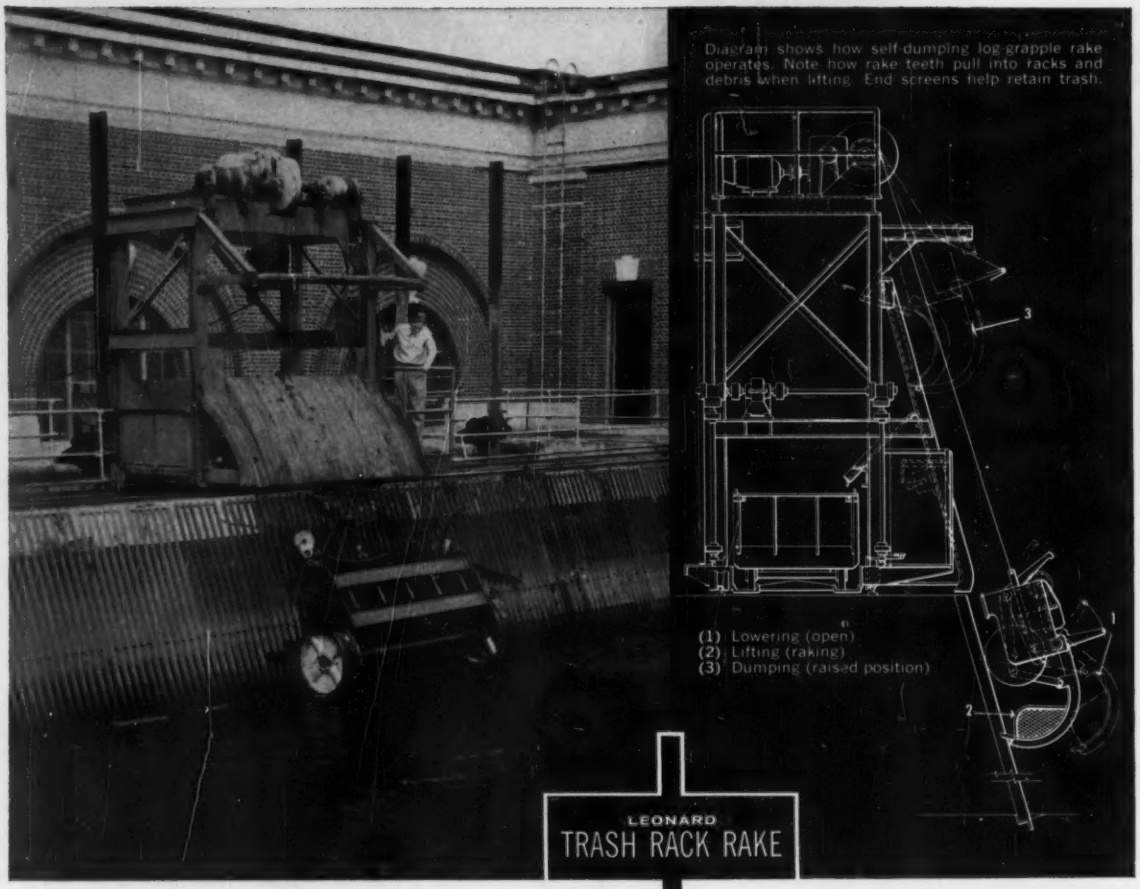
Mount switch and cross arm on pole, then tilt pole into position.

Details in complete catalog. Why not order test installation?

KPF ELECTRIC COMPANY
Dept. E, 1624 E. Alpine Avenue
Stockton 5, California

KPF
AIR BREAK SWITCHES
Standard for nearly half a century

3094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(1) Lowering (open)
(2) Lifting (raking)
(3) Dumping (raised position)
LEONARD
TRASH RACK RAKE

New 8-foot, self-dumping SMS rake at Niagara Mohawk Power Corporation's Black River Station is one of five recently installed by this company.

Two New Self-Dumping SMS Trash Rake Designs CUT CLEANING TIME AND LABOR

Now SMS offers you two improved Leonard trash rack rakes, both regular and log-grapple types. These self-dumping rake designs make operation easier and quicker, permit you to clean a greater area faster. Both new rake types are now available as additions to the SMS line of standard rake designs.

SMS Leonard rakes operate directly on trash rack bars . . . ride down over stubborn obstructions and work them loose. Such freedom of movement assures fast, easy cleaning. Initial costs are low because the width of SMS rakes can be kept to the minimum required for handling for trash and the expense of guides attached to racks, or embedded in piers is eliminated. These rakes are of simple and rugged construction, designed for outdoor service and require minimum maintenance.

To get full information on Leonard trash rakes, or on other SMS accessories and hydraulic turbines, write to S. Morgan Smith Co., York, Penna. For Leonard rakes, request Bulletin 158.

S. MORGAN SMITH

AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

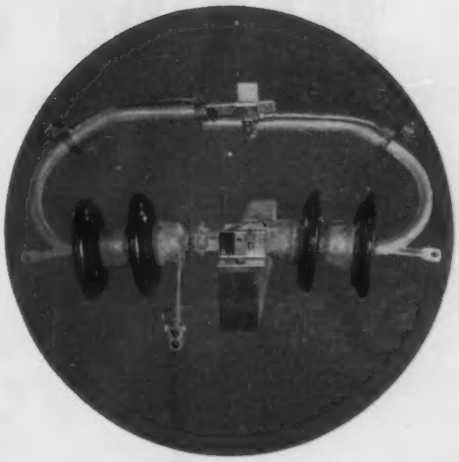
HYDRAULIC TURBINES · GATES & HOISTS · TRASH RAKES · PUMPS · LIQUID HEATERS

HYDRODYNAMICS

ROTOVALVES · FREE DISCHARGE VALVES · BALL VALVES · CONTROLLABLE-PITCH SHIP PROPELLERS · BUTTERFLY VALVES

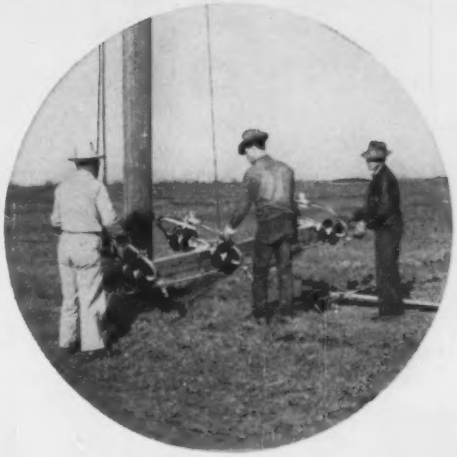
Licensees: The Harland Engineering Company, Ltd., Alloa, Scotland • Tokyo Shibaura Electric Co., Ltd., Japan

You can install KPF switches more quickly, at less cost, than any comparable switch. Just bore six holes in a single cross arm, mount, and connect. No precision requirements, no temperamental mechanism to bind, freeze, malfunction or need lubrication. Just simple, cleanly designed parts, arranged in a rugged, foolproof manner for trouble-free operation. The economy and dependability of KPF switches has been proved on major utility systems for almost 50 years.



install in the air — or on the ground

Mount phase units individually to pre-installed cross arm on the pole top.



Assemble complete switch on the cross arm before arm is installed on pole.

Mount switch and cross arm on pole, then tilt pole into position.

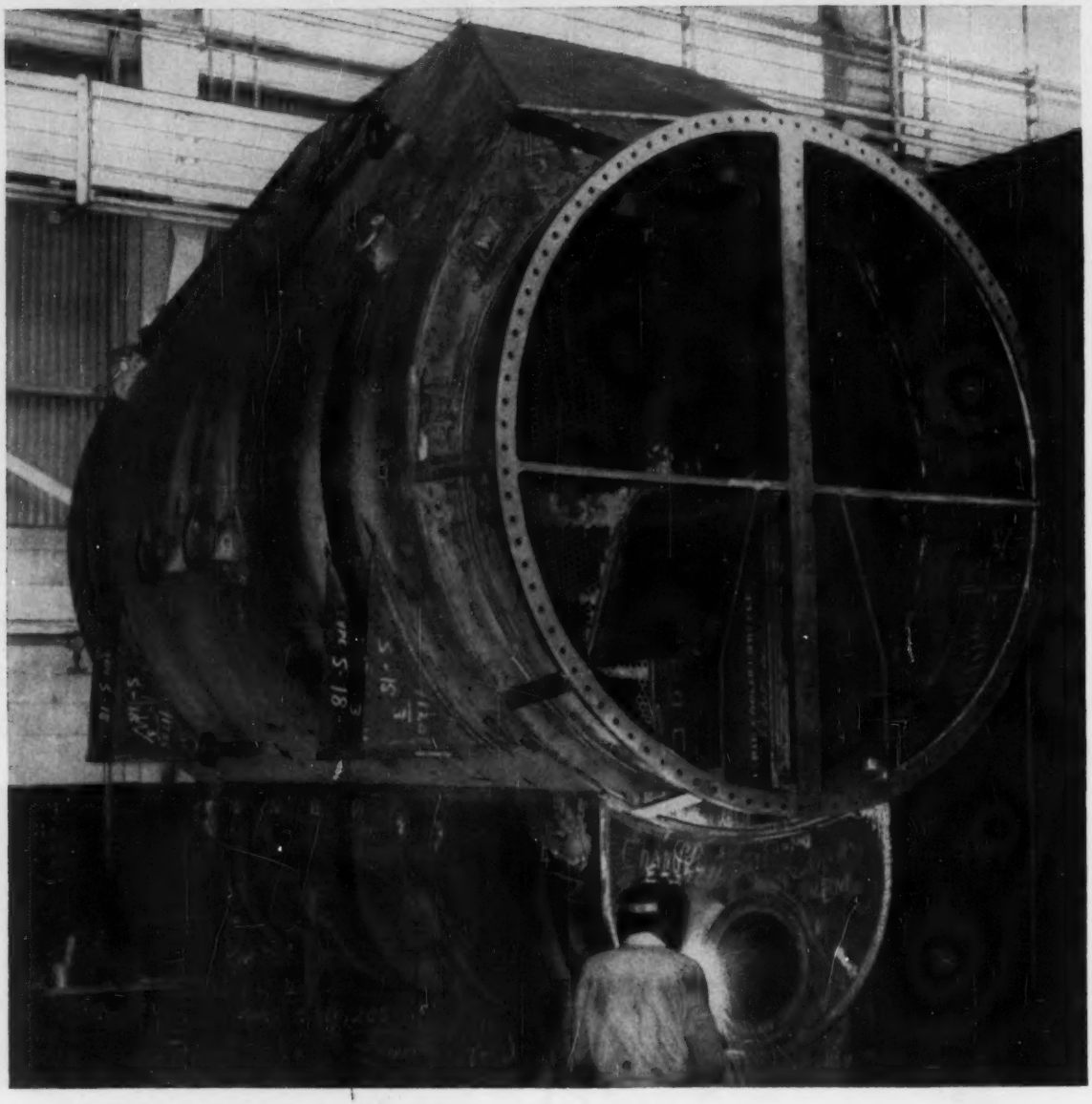
Details in complete catalog.
Why not order test installation?

KPF ELECTRIC COMPANY
Dept. E, 1624 E. Alpine Avenue
Stockton 5, California

KPF
AIR BREAK SWITCHES
Standard for nearly half a century

MARIND CONDENSERS

ECONOMY • RELIABILITY • PERFORMANCE



Thoroughly experienced design engineering and manufacturing staff. Every Marind job is backed by this Company's international reputation for outstanding quality, service, performance.

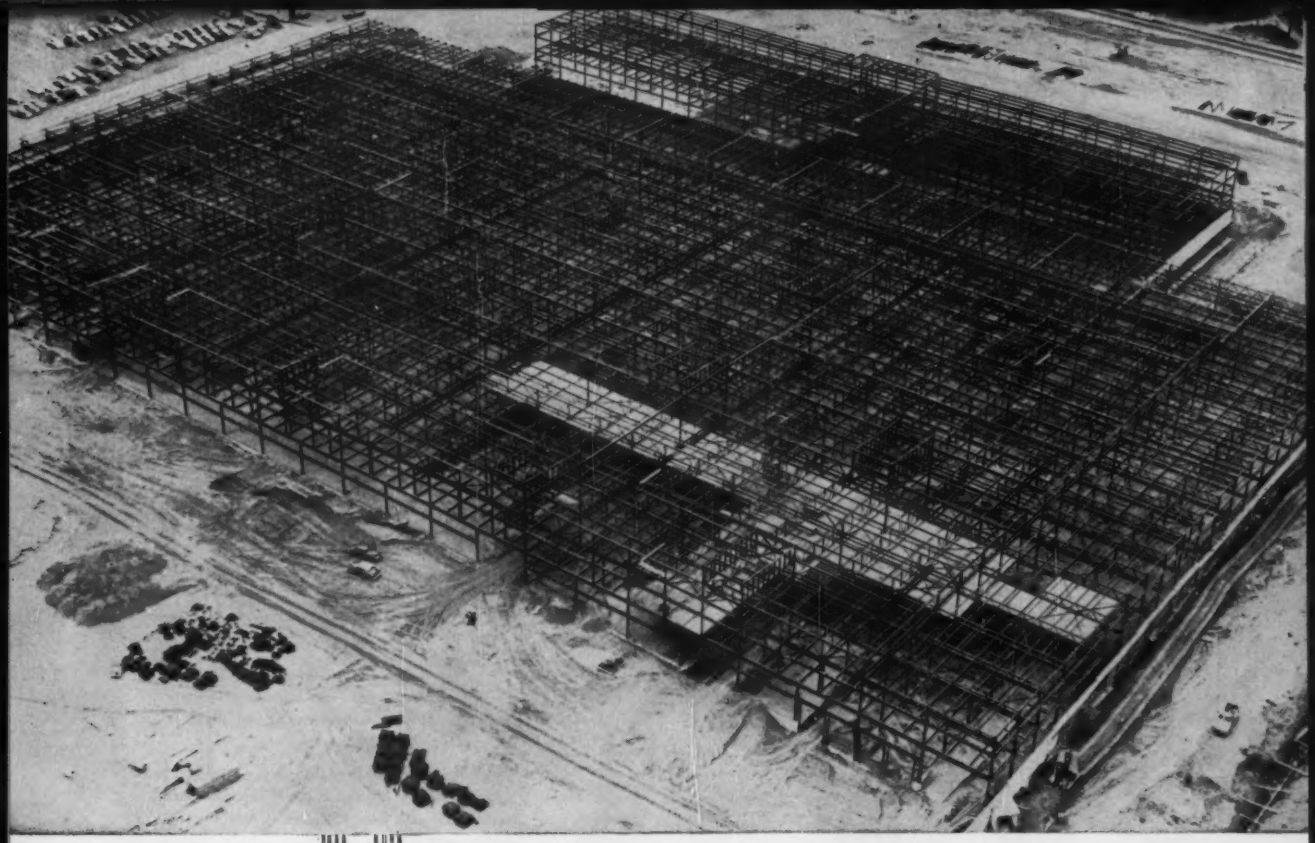
MARIND

POWER • INDUSTRIAL EQUIPMENT

Industrial Products Division

MARYLAND SHIPBUILDING & DRYDOCK COMPANY

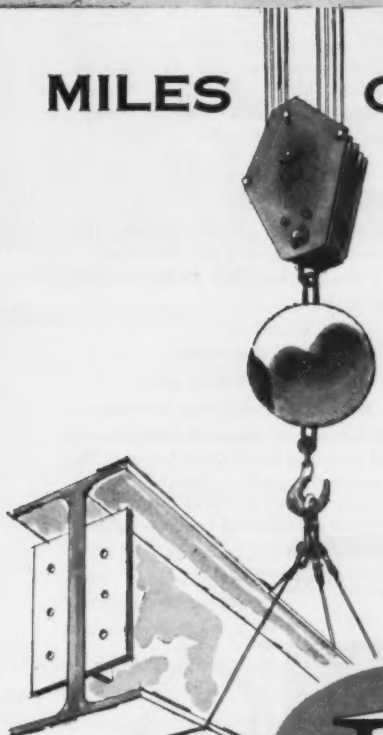
BALTIMORE 3, MARYLAND • *Representatives in Principal Cities*



MILES OF STEEL STRENGTH IN THE MERRIMACK VALLEY

Miles of steel — 51 hundred tons of it — were fabricated by The Ingalls Iron Works Company for this giant, modern Western Electric plant at North Andover, Mass., in the Merrimack Valley. Once again, Ingalls-fabricated steel has been specified on a major job!

Hundreds of important industrial planners throughout the United States depend on The Ingalls Iron Works Company for the fabrication of steel for their new buildings, bridges, power houses, and other needs. In many cases, The Ingalls Steel Construction Company handles the erection of our steel — including plate work, supplied by Birmingham Tank Company. We congratulate Western Electric on its major expansion, and take pride in serving in America's strong industrial growth.



THE INGALLS

FABRICATING STEEL
IS OUR BUSINESS!

IRON WORKS COMPANY
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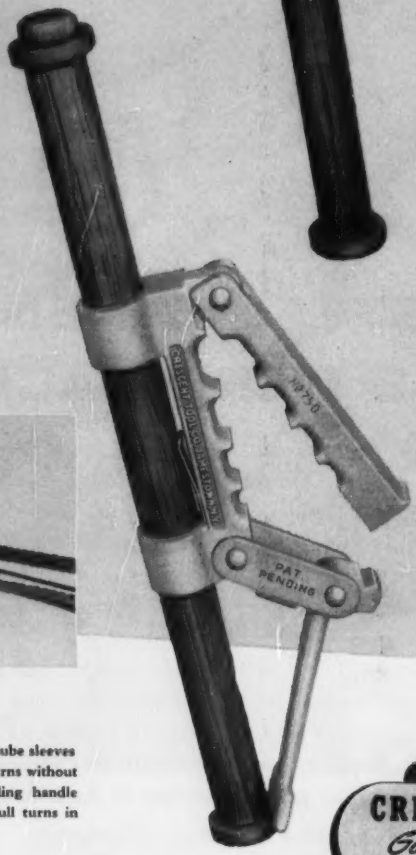
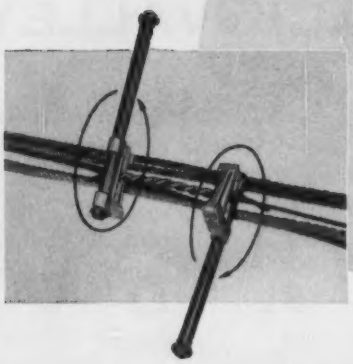
SALES OFFICES: New York, Chicago, Pittsburgh, Houston, Atlanta, New Orleans
PLANTS: Birmingham, Ala.; Verona, Pa.; Pascagoula, Miss.; North Birmingham, Ala.; Decatur, Ala.

CRESCENT SLEEVE WRENCHES

insure better joints... ...faster and safer to use





Both single and double tube sleeves can be twisted six full turns without cracking or injury. Sliding handle clears tackle, allowing full turns in close quarters.

FEATURES

Oil impregnated hickory handle makes practically perfect insulation, preventing flash if contacted with hot wire.

Cam and lever action closes jaws easily and locks positively when closed. Readily released with one hand even with heavy gloves. Conveniently carried in loop of tool belt.

Design of the openings is such that maximum strength of the joint is secured. Tests indicate that joints made with No. 730 Sleeve Wrench give nearer 100 percent of the theoretical strength of the sleeve than with any other method.

SPECIFICATIONS

Finish—Metal parts are cadmium plated. Hickory handle impregnated with linseed oil.

Material—Jaws and cam lever are heat treated, forged steel.

Length—Overall, 20 inches.

Weight—5 lbs. 3 oz. a pair, boxed.

Packed—Two in a box. Order in pairs.

Handles—Handles 20 inches long are standard.

Capacity—Any sleeve, copper or aluminum, up to and including No. 3/0 solid copper, No. 2/0 stranded copper or No. 1/0 ACSR. Two, three or four openings can be put in one wrench, depending on opening sizes.

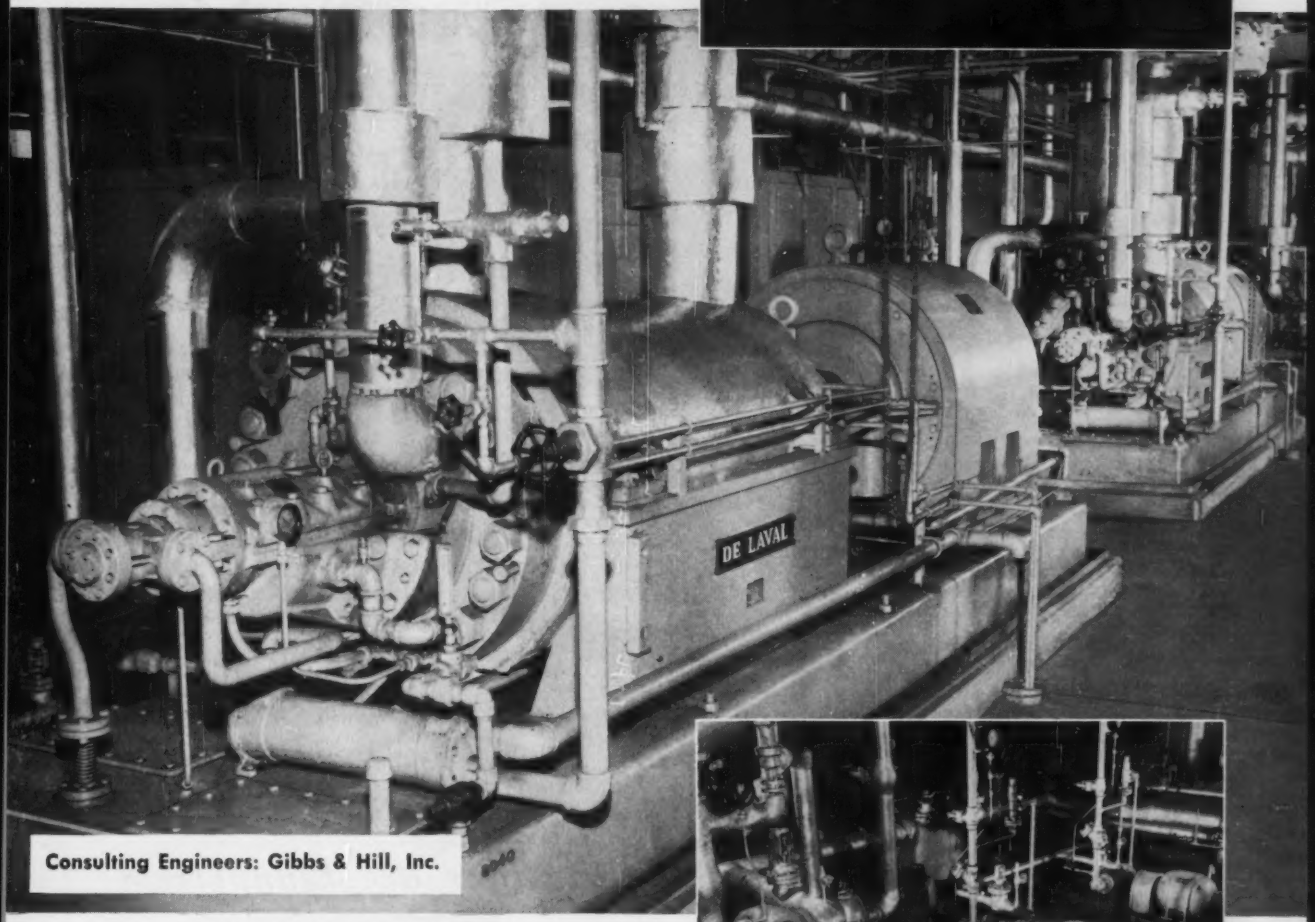
CRESCENT TOOLS
Give Wings to Work
Sign of the Artisan
Symbol of Excellence
®

Crescent is our trade-mark, registered in the United States and abroad, for wrenches and other tools. Sold by leading distributors and retailers everywhere and made only by

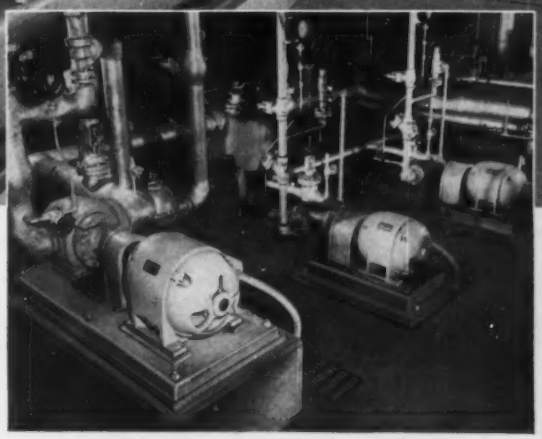
CRESCENT TOOL COMPANY, JAMESTOWN, NEW YORK

Atlantic City Electric ... another utility using

DE LAVAL
BARREL TYPE BOILER FEED PUMPS



Consulting Engineers: Gibbs & Hill, Inc.



De Laval IMO rotary positive displacement pumps handle heavy fuel oil. They are used for standby operation.

Atlantic City Electric Co. and Gibbs & Hill, Inc., Consulting Engineers, know that they can count on De Laval reliability. That's why they selected three De Laval high pressure barrel type boiler feed pumps for the Deepwater Station in Penns Grove, New Jersey. These 10-stage units deliver 675 gpm, operating at 1762 psi with temperature at 287 F. The pumps are driven by 900 hp motors.

De Laval barrel type boiler feed pumps operate at pressures up to 5500 psi. These units offer many important design advantages, such as double volute diaphragm, individual diaphragm bolting, only one inner high-pressure joint, and bare shaft construction. Their dependability is proven by year in, year out service in public utilities and industrial plants.

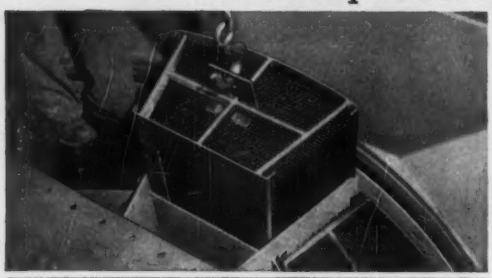
Readers of this publication can obtain the De Laval Engineering Handbook (Regular Price $3.00) for one dollar. Its 336 pages contain mathematical, mechanical, fluid and other data on turbines, pumps, compressors and reduction gearing. Write for your copy.

DE LAVAL *Boiler Feed Pumps*

DE LAVAL STEAM TURBINE COMPANY
861 Nottingham Way, Trenton 2, New Jersey

GL-949

air preheater installations are Ljungstrom®



Advantages of the Ljungstrom Air Preheater

- Size for size, recovers more heat than any other type.
- Reduces fuel consumption. Permits use of lower-grade fuels. Increases boiler output and reliability.
- Eliminates cold spots...keeps corrosion to a minimum.
- Easier, faster to clean and maintain.
- Requires far less supporting steel and is quickly erected.

MINIMUM CORROSION is an important reason. There are no cold spots in a Ljungstrom. Temperature is uniform on all heating surfaces—corrosion-causing condensation is reduced.

For all the facts, send now for a free copy of our 38-page manual.

The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.

POLYPHASE METERING:

Current transformers provide built-in adaptability for future load growth

When polyphase loads go over 100 amperes—it's time to install Sangamo Type R Current Transformers. Their unique adaptability encourages simple economical installations that eliminate the need for larger self-contained meters which have only limited capacity for still further expansion.

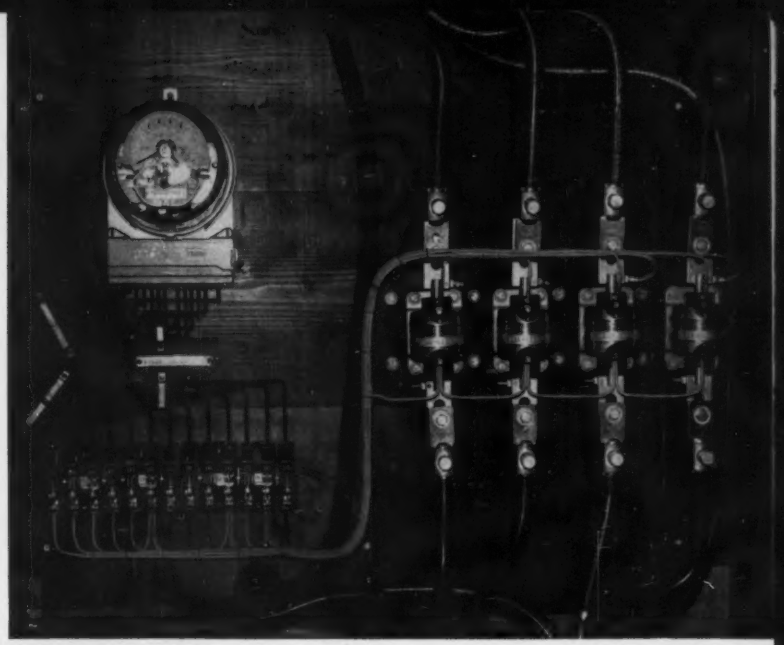
Sangamo Type R Transformers can be used as bar-primary-types or window-types, with or without auxiliary mounting plates, and are light enough to be fully supported by the primary conductor.

Available in 200 and 400 ampere ratings, in eight variations that permit almost any primary arrangement.

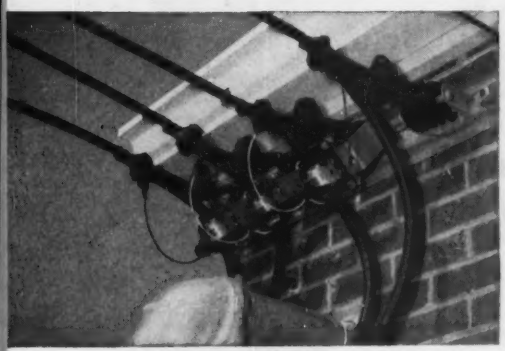
Ask your Sangamo Representative, or write us for Bulletins 501 and 150 for detailed information on Type R Transformers and mounting racks.

SANGAMO ELECTRIC COMPANY

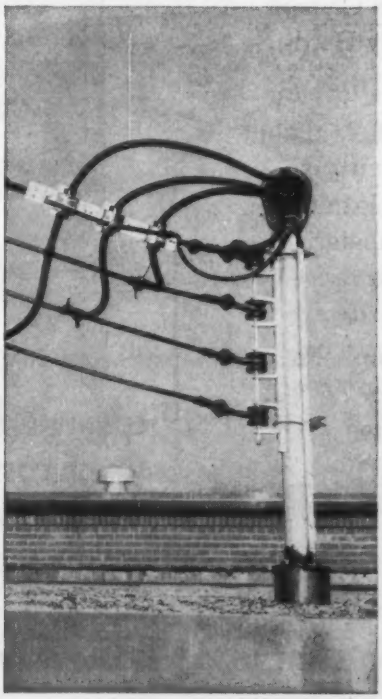
SPRINGFIELD, ILLINOIS



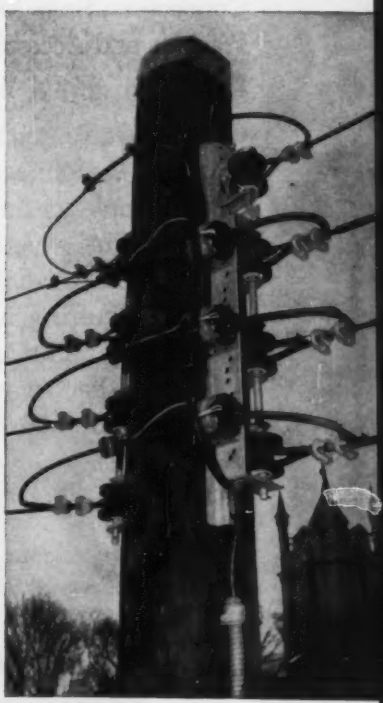
Meter Box Installation measuring 3-wire three-phase and 3-wire single-phase from separate sources on one meter using four Type RF-6A Sangamo Current Transformers.



Three Type RC-6A Current Transformers are supported on a horizontal secondary wire Sangamo Transrack.

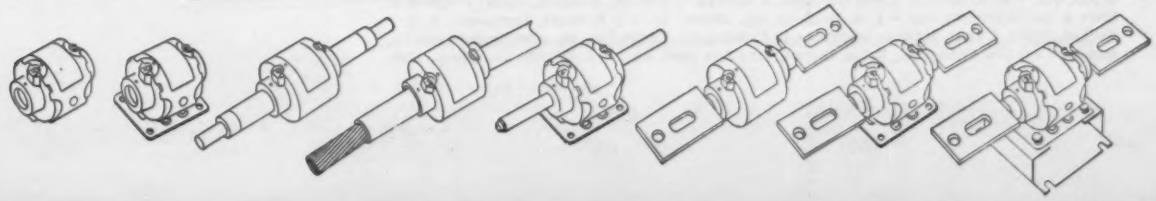


Service entrance mast installation with three Sangamo Type RC-6A Transformers mounted on a Transrack supported by the grounded neutral.



This pole-top installation shows three Sangamo R-6 Current Transformers supported by the secondary rack.

Eight variations of ONE BASIC TRANSFORMER permit the engineer to devise many other economical installations.



SM56-8

MIF

malleable iron

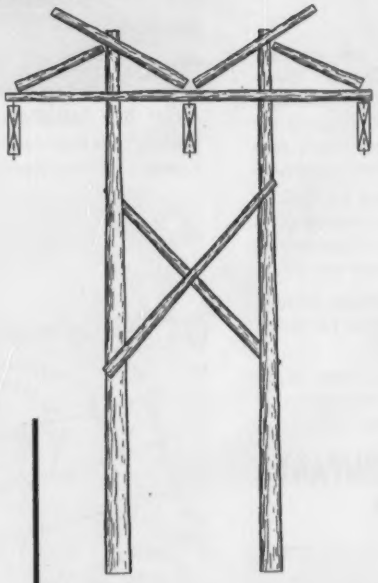
high corrosion resistant

TRANSMISSION LINE FRAMING HARDWARE!

Only MIF offers a complete line of fully engineered, field tested, *malleable iron* framing hardware: Grid Gains; Timber Connectors; Spar Arm Gains; Washers and Accessory Hardware.

Only *malleable iron* offers the engineer the opportunity to design complex or simple framing structures where material strength and corrosion resistance in framing hardware assures a longer and more balanced life expectancy throughout the structure..... *without increasing cost!*

For further information
Write for Bulletin PH 10.



LONGER LIFE
LOWER COST
EASIER INSTALLATION
FEWER DESIGN LIMITATIONS

MALLEABLE IRON FITTINGS COMPANY

POLE HARDWARE DIVISION

Branford, Connecticut

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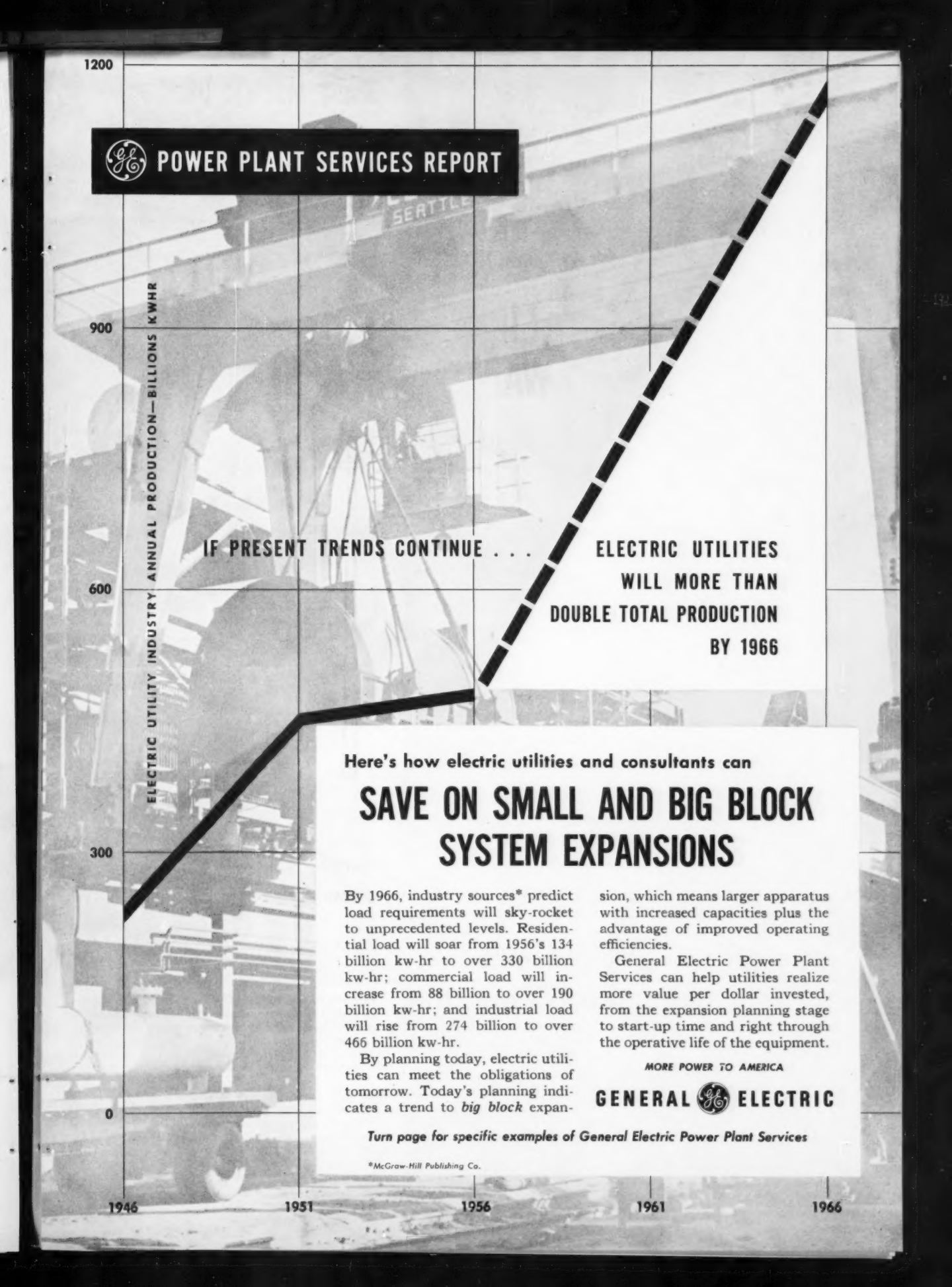


POWER PLANT SERVICES REPORT

IF PRESENT TRENDS CONTINUE . . . ELECTRIC UTILITIES WILL MORE THAN DOUBLE TOTAL PRODUCTION BY 1966

Here's how electric utilities and consultants can

SAVE ON SMALL AND BIG BLOCK SYSTEM EXPANSIONS

By 1966, industry sources* predict load requirements will sky-rocket to unprecedented levels. Residential load will soar from 1956's 134 billion kw-hr to over 330 billion kw-hr; commercial load will increase from 88 billion to over 190 billion kw-hr; and industrial load will rise from 274 billion to over 466 billion kw-hr.

By planning today, electric utilities can meet the obligations of tomorrow. Today's planning indicates a trend to *big block* expansion, which means larger apparatus with increased capacities plus the advantage of improved operating efficiencies.

General Electric Power Plant Services can help utilities realize more value per dollar invested, from the expansion planning stage to start-up time and right through the operative life of the equipment.

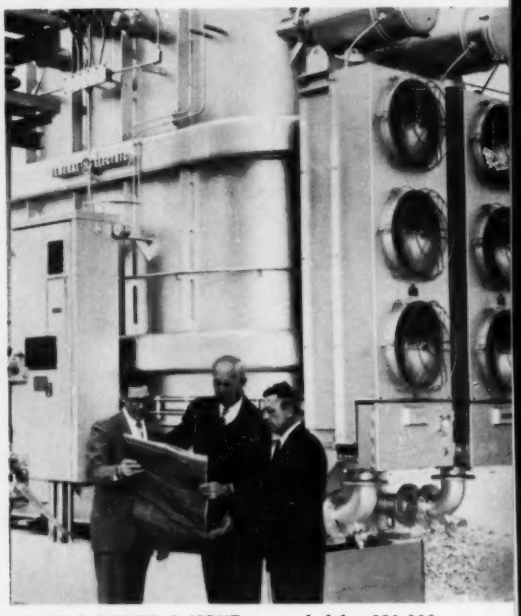
MORE POWER TO AMERICA

GENERAL ELECTRIC

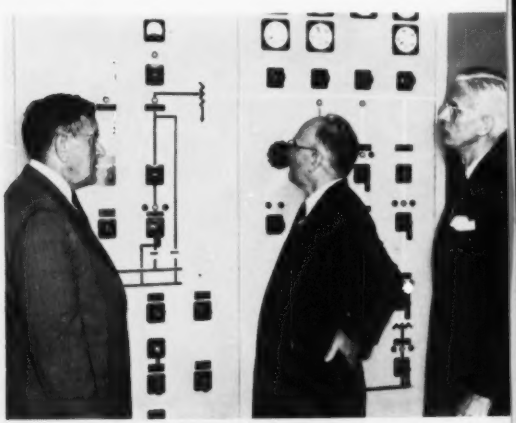
Turn page for specific examples of General Electric Power Plant Services

*McGraw-Hill Publishing Co.

Many electric utilities
Save valuable



FLORIDA POWER & LIGHT expanded by 231,000 kw, nameplate rating, with G-E equipment at Cutler station. L. H. Hill, Jr., G.E.; E. J. Pearch, Station Supt.; J. W. Lacy, Jr., G.E; note G.E.'s co-ordination of details on 42,500-kva FOA power transformer conserved engineering time.

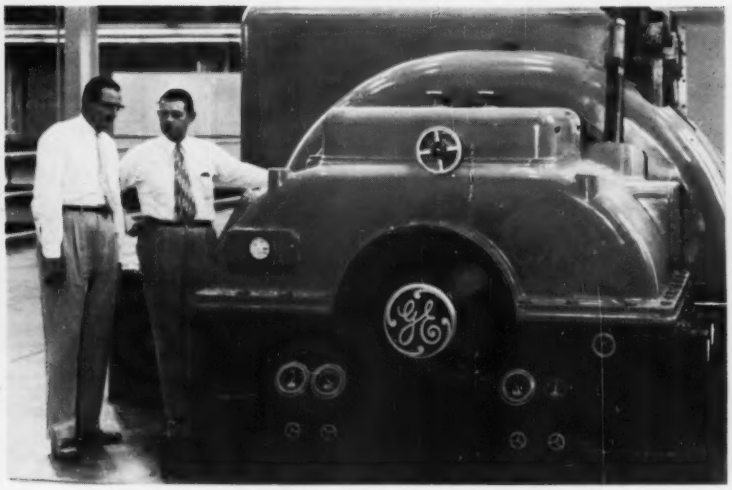


OKLAHOMA GAS & ELECTRIC stepped up capacity 20% with all-G.E. Arbuckle station. G.E.'s scheduling speeded construction, meant on-time start-up, as noted by L. Skog, Pres., Sargent & Lundy; W. B. Gesell, V. Pres., OG&E; C. H. Linder, G-E Vice Pres., at G-E master control panel.

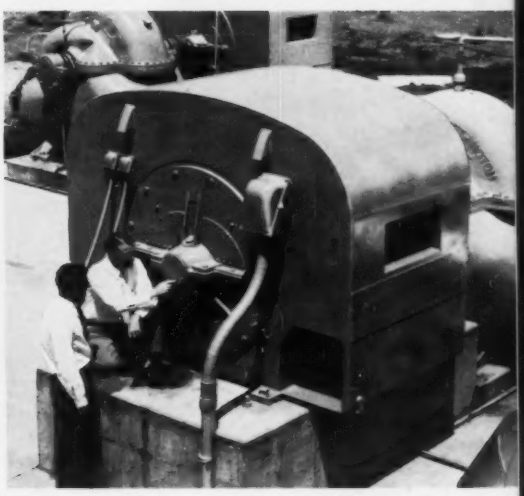
PACIFIC GAS & ELECTRIC'S Pittsburg station produces 660,000-kw; G-E equipment includes 230-kv breakers. Left, J. Anderson, G.E.; K. Bausch, R. Stater, Bechtel (engrs. & constructors); G.E.'s J. D. Webster note how G-E Power Plant Services meant integrated equipment designs.

like these . . .

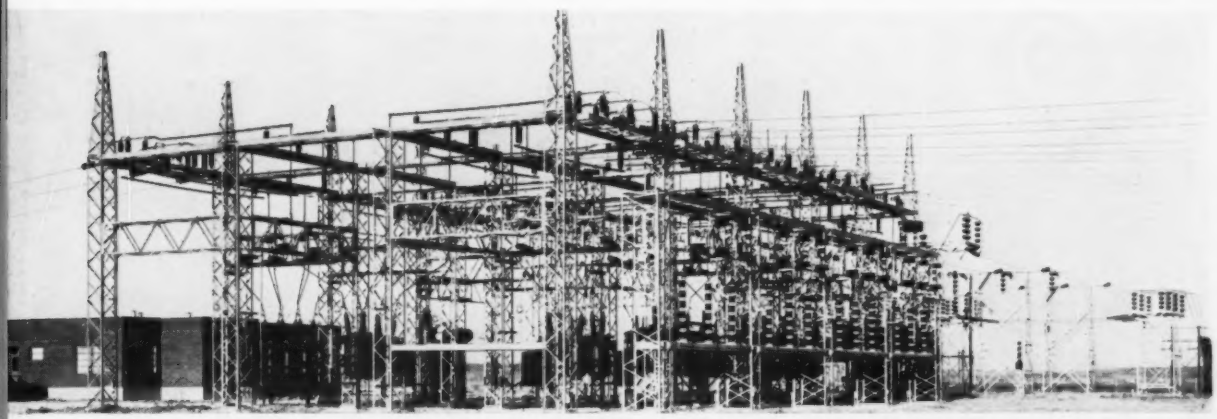
time, money and manhours with General Electric Power Plant Services



SOUTH CAROLINA ELECTRIC & GAS raised total capacity 20% with its 100,000 kw G-E turbine generator at the Urquhart Station. Above, General Electric's M.O. Troy, Jr. and F.R. McMeekin, Vice President of SCE&G, note that purchase of this third G-E unit plus other major electrical equipment simplified ordering of equipment, hastened start-up time.



MISSISSIPPI POWER & LIGHT'S all-G.E. 210,000-kw Delta steam plant was started up on schedule, G-E engineers trained operators to assure MP&L full operating knowledge of equipment, noted here by G.E.'s T. R. Brock, MP&L's D. C. Lutken.



IOWA POWER AND LIGHT COMPANY'S Council Bluffs steam station bolstered capacity by 44,000 kw. Installation help, including h-v switchyard shown here, speeded start-up.

For details on Power Plant Services, contact your G-E Apparatus Sales Representative or write Section 302-12, General Electric Company, Schenectady 5, New York.

GENERAL ELECTRIC

For more data on how G-E power plant services work for you, see next page ►

POWER PLANT SERVICES REPORT

These are the cost-saving power plant services on your job when you specify General Electric

APPLICATION ENGINEERING co-ordinates all items of electrical equipment in design, operation. Here, at model of Hartford Electric Light's 66,000-kw G-E equipped Middletown station, are G.E.'s F. C. Roberts, HELCO's J. C. Sonntag and K. L. Partridge; G.E.'s A. P. Wylie; and HELCO's S. Kusmik, D. C. Switzer and H. T. Barrows.

PRODUCT DEVELOPMENT gives you equipment incorporating latest design features. Above, Kansas City Power & Light Vice President J. A. Keeth, G.E.'s C. M. Sagmoen and H. S. Day discuss General Electric automatic dispatching equipment in operation on Kansas City Power & Light's system.

FIELD SERVICE ENGINEERING assures supervised installation, planned start-up. Above, Central Hudson Gas & Electric's Danskammer Point station unit No. 2 is discussed by G.E.'s C. B. Wilson; Ralph Roe, Pres., Burns & Roe; W. West, G.E.; R. B. MacGuinness, Vice Pres., CHG&E.

POWER PLANT CO-ORDINATION helped assure on-time manufacture, delivery of equipment at plant site of Indianapolis Power & Light's White River station. IP&L's Vice Pres. D. C. Hess, J. D. Blythe, President H. T. Pritchard, review delivery schedules with John Calder, G-E Sales Engineer.

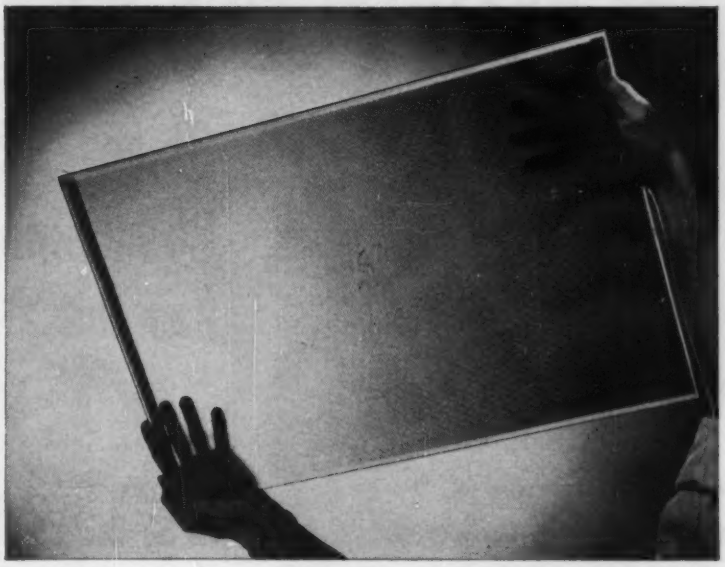
SERVICE ENGINEERING helps keep plant operating at full capability. At Central Power & Light's G-E equipped 132,000-kw Lon C. Hill plant, G.E.'s R. M. Eichner reviews with Mark Lovelady, CP&L Vice Pres. and Chief Engineer, a planned equipment maintenance schedule.

MORE POWER TO AMERICA

GENERAL ELECTRIC

LIVE BETTER ELECTRICALLY

This is the radiant heating panel backed by the PYREX trademark



And it's the only glass panel with a one-year warranty

You can rely on the proven dependability of this low-temperature-source panel to help you build your electric home heat load.

Every PYREX panel is warranted by Corning Glass Works for one full year. If, during the first year of service, a panel fails due to a defect in the glass panel, Corning will replace the panel at no cost to the manufacturer.

You can recommend the PYREX brand glass radiant panel *confidently*.

High wattage output

Because PYREX radiant panels are tempered borosilicate glass, they pack more watts per unit. One PYREX unit, for example, gives you up to 3,000 watts output in permanent installation heaters. And tempering further increases resistance to thermal shock and mechanical impacts.

With this panel, you lower the initial cost of an electrical heating system and you reduce installation costs, as well.

Full radiation

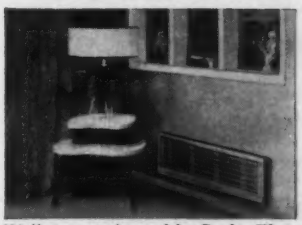
The entire back surface of the PYREX panel is coated with an electrically conductive metallic deposit. Thus, the entire panel area radiates long-wavelength infrared rays.

With the PYREX panel you get lower operating costs than with other, less efficient elements. There is no heavy starting surge.

Send for full information

The PYREX panel is available to you now with years of satisfactory performance behind it. Homeowners are using it in built-in systems and in portable units.

If yours is among the utilities promoting electric heat, we would like to give you the information you need to judge this panel's place in your program. To get this data, write, wire or phone us.



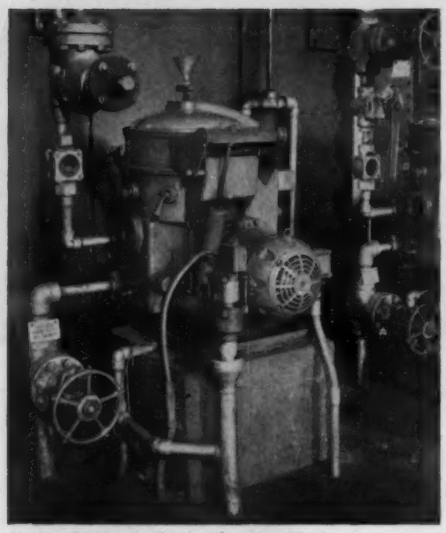
Wall-mounted panel by Berko Electric Manufacturing Corp. Easy to install. The baseboard elements use PYREX panels, too.

New Arvin portable electric automatic heater with PYREX panel heating element.

CORNING GLASS WORKS, CORNING, N. Y.
39-10 CRYSTAL STREET
Corning means research in Glass

MORE PROOF THAT DE LAVAL OFFERS THE BEST TURBINE PROTECTION!

Since 1920 Philadelphia Electric Co. has installed 45 DE LAVAL PURIFIERS!



De Laval "Uni-Matic" Purifier No. 67-13 at Philadelphia Electric's Delaware Station...continuously delivers a highly purified oil at maximum capacity and minimum expense.

Philadelphia Electric Company's Cromby electric generating station, located along the Schuylkill River, near Phoenixville, Pa. This station, completed in 1955, has a generating capacity of 385,000 kilowatts.

PARTIAL LIST
of
DE LAVAL PURIFIERS
Purchased by
PHILADELPHIA ELECTRIC CO.

Date of Purchase	Model	Quantity
4/20	600	1
10/23	300	1
2/24	600	3
9/24	300	1
6/25	600	1
10/26	600	1
1/28	202	6
4/29	202	2
7/31	202	1
1/32	302	1
5/35	65-13	1
4/37	65-13	1
12/37	55-13	1
3/38	65-13	1
4/39	55-23	1
6/40	74-01	1
5/41	74-01	1
2/45	74-21	5
2/45	55-23	2
7/49	45-23P	1
1/51	45-23P	1
4/51	67-23	5
8/51	67-23	1
10/54	65-13	1
11/55	65-13	2
6/56	67-13	2

DE LAVAL SEPARATOR COMPANY

THE DE LAVAL SEPARATOR COMPANY Poughkeepsie, New York • 427 Randolph St., Chicago 6 • DE LAVAL PACIFIC CO. 201 E. Millbrae Ave., Millbrae, Calif.

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The cables that help keep automation automatic

Where you have remote, supervisory or other types of control, failure of just one wire could be costly. That's why so many automatically say Anaconda for control cable.

You too will rest easier knowing *your* cable is made by people with years of experience in producing the most complex of power cables. At Anaconda, quality control procedures are rigidly adhered to, and research works constantly for better performance.

A big family of Anaconda control cables offers you the *right* cable for every job:

1. *Rubber insulation, neoprene-covered, neoprene jacket over-all*
2. *Rubber insulation, braid-covered, neoprene jacket over-all*
3. *Polyethylene insulation, polyvinyl chloride jacket*
4. *PVC insulation, and polyvinyl chloride jacket*
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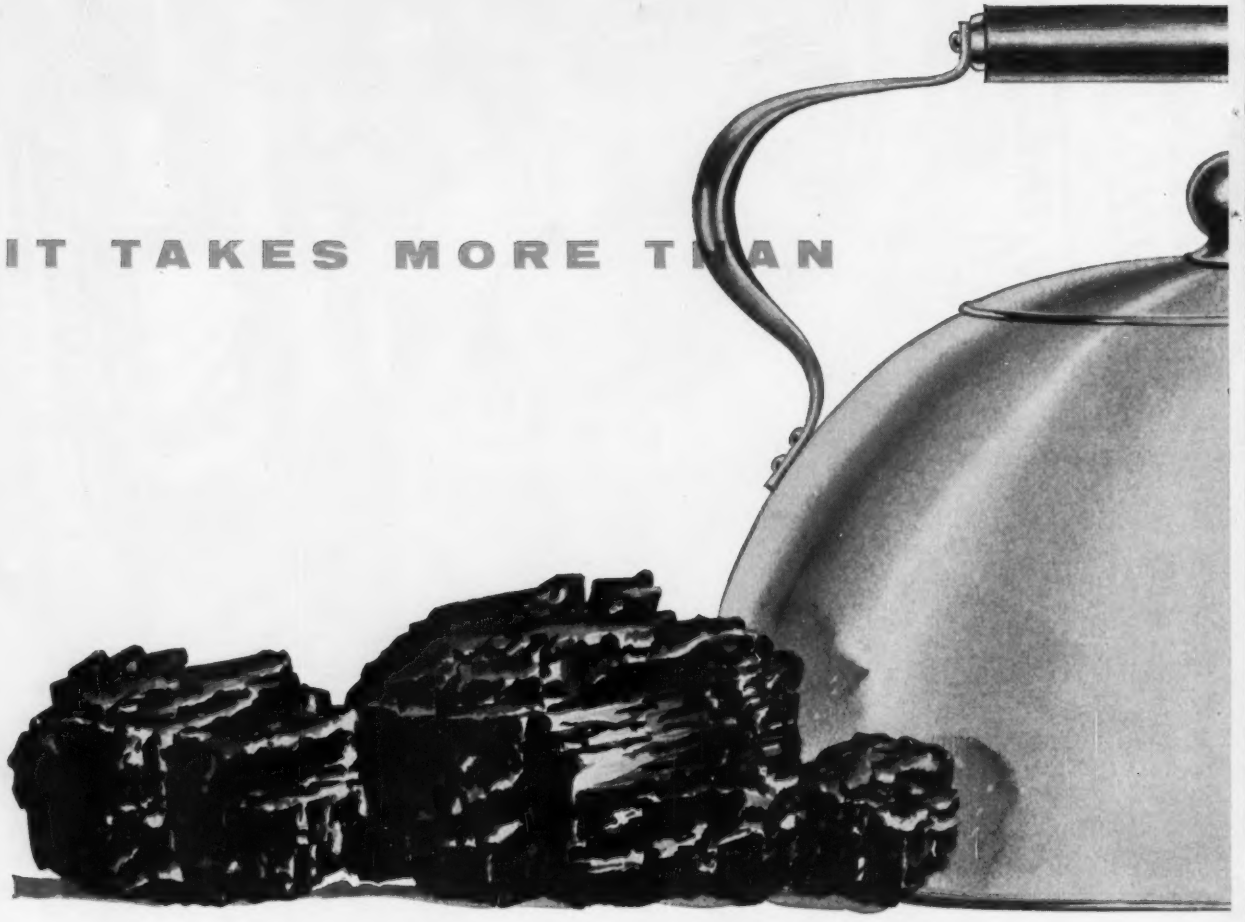
Conductors with printed coding are available – speed work, assure accuracy, and are permanently marked. See the Man from Anaconda or your nearest Anaconda distributor for full information and special application engineering aid. Or write about your cable requirements to: Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y.

SEE THE MAN FROM **ANACONDA®**

FOR YOUR **CONTROL CABLE**

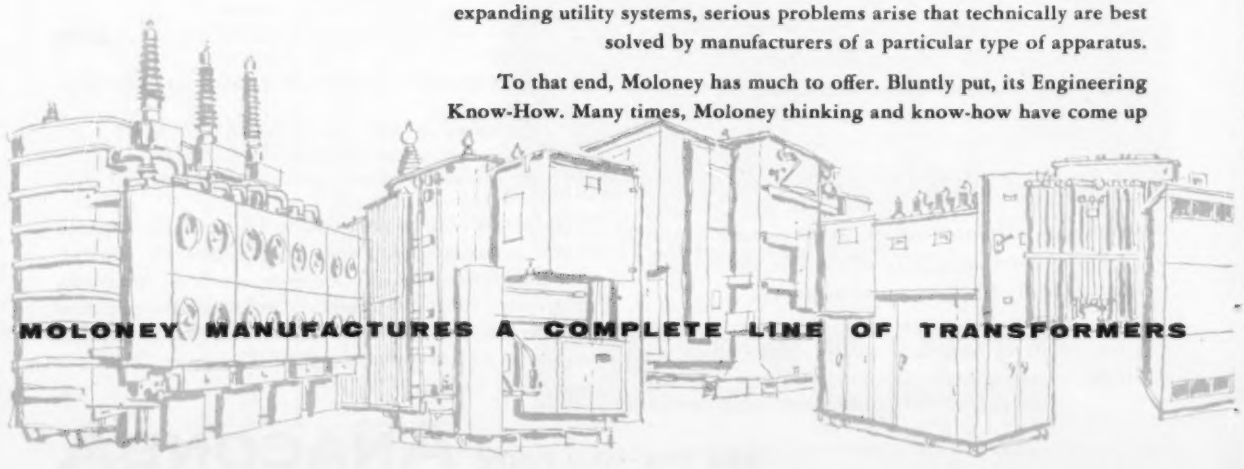
IT TAKES MORE T[illegible]AN



Indeed yes! The utilities present a fabulous picture that quite often is difficult for casual observers to understand. Perhaps the most important aspect in addition to capital and physical structure is the system planning and engineering necessary to perform the primary function of service.

Of vital importance too, are the utility suppliers who furnish the many items the utility must have to operate. Quite often in planning and expanding utility systems, serious problems arise that technically are best solved by manufacturers of a particular type of apparatus.

To that end, Moloney has much to offer. Bluntly put, its Engineering Know-How. Many times, Moloney thinking and know-how have come up



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with the proper and best solution. As in the past, Moloney stands ready and able to help utilities today and in the future. How? With engineering capacity, with augmented production capacity well fortified with an aggressive and constant research and development program.

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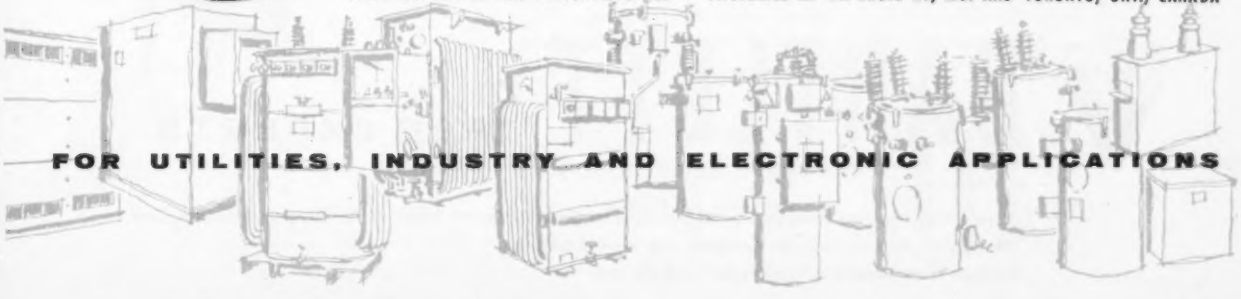

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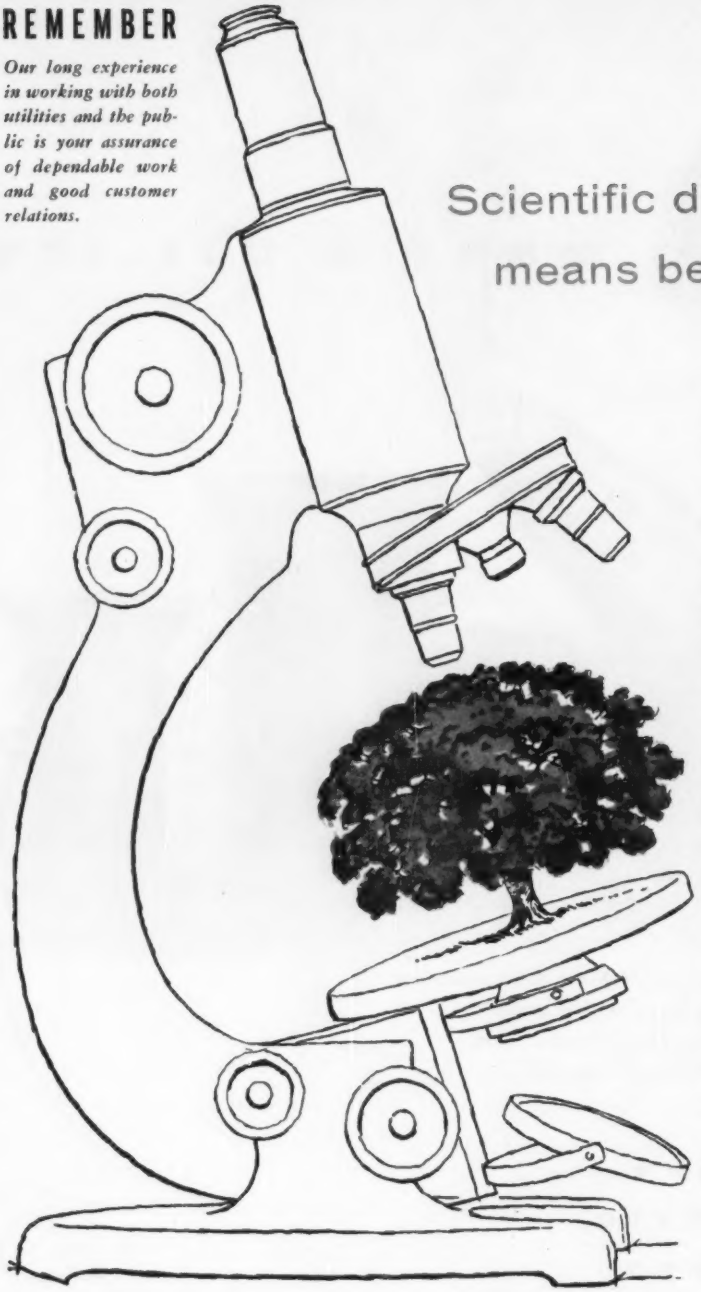

Scientific diagnosis means better tree care . . .

The basis of any curative treatment for either plants or animals is accurate diagnosis, plus the skill and experience to bring it to a successful conclusion. This means research, not guesswork as well as the best of equipment and ability.

You won't see many tree laboratories comparable to our 200-acre experimental ground and research unit at Stamford, Connecticut, where the day-to-day problems encountered by our field men are diagnosed and ideas for the protection of shade trees are tested and developed under actual growing conditions. These laboratories call for a big investment in both time and money. But to us who want to be sure of results, this painstaking research for the best possible treatment is worth it.

Couple this with an efficient highly skilled field force, thoroughly familiar with local conditions, and you have the well balanced Bartlett organization capable not only of rendering scientific diagnosis but of executing the prescribed treatment in efficient, economical fashion. It is the reason why more and more people are turning to the Bartlett Way—the Scientific Way. It costs no more and it is safer and more economical in the long run.

Consult your local Bartlett representative today for a study of your tree situation. You will benefit by his recommendations.

The Bartlett Way

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LOW VOLTAGE SWITCHGEAR through 600 v a-c, 250 v d-c, 15,000 through 150,000 amp interrupting, 6000 amp continuous.

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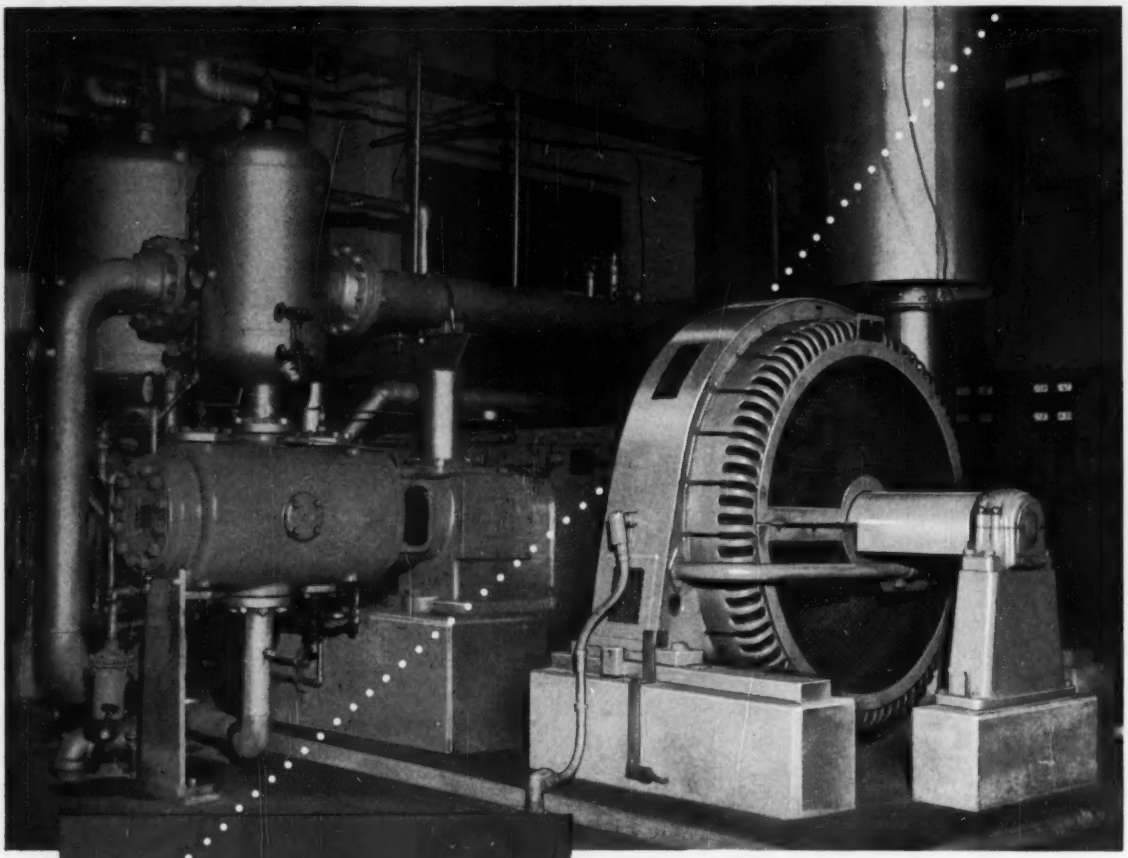
On big, important compressor drives, like this



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ONE OF THE WORLD'S LARGEST SOOT BLOWER COMPRESSOR INSTALLATIONS is located in the famous Joppa Steam Electric Station of Electric Energy, Inc. There are six giant soot blower compressors, like the one pictured above – all driven by large Elliott 800-hp, 400-rpm synchronous motors. These motors are engine type with modern split-rotor construction. As is the case with all Elliott synchronous motor installations, the application of the motors was done with great care and consideration of all the complexities which accompany modern compressor drives. Elliott experience in compressor drives of all sizes and types is second to none, as attested by hundreds of successful installations. Ask your Elliott field engineer or write to Elliott Company, Ridgway, Pa., for full details.

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with Republic ELECTRUNITE E.M.T.

Saving dollars is a certainty on practically every Republic ELECTRUNITE® E.M.T. job because installation is so easy.

Here's an electrical conduit that will provide years of dependable protection at less cost. Utility jobs installed more than 25 years ago are still giving users trouble-free service. And the amount of footage successfully installed in concrete is in the hundreds of millions.

There's no kinking . . . no wrinkling — because ELECTRUNITE is *uniformly ductile.* Installation is faster because ELECTRUNITE E.M.T. is lighter. And less weight means easier handling, lower costs.

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It will pay you to check the cost advantages of Republic ELECTRUNITE E.M.T.—the electrical conduit that offers such exclusive features as "Inch-Marked"® and "Guide-Lined." It's produced to ASA specification C-80.3, Federal Specification WW-T-806 and carries the Underwriters' Laboratories Seal of Inspection. Write for all the facts. *Send for your free copy of 84-page* ELECTRUNITE *bending instruction booklet.*

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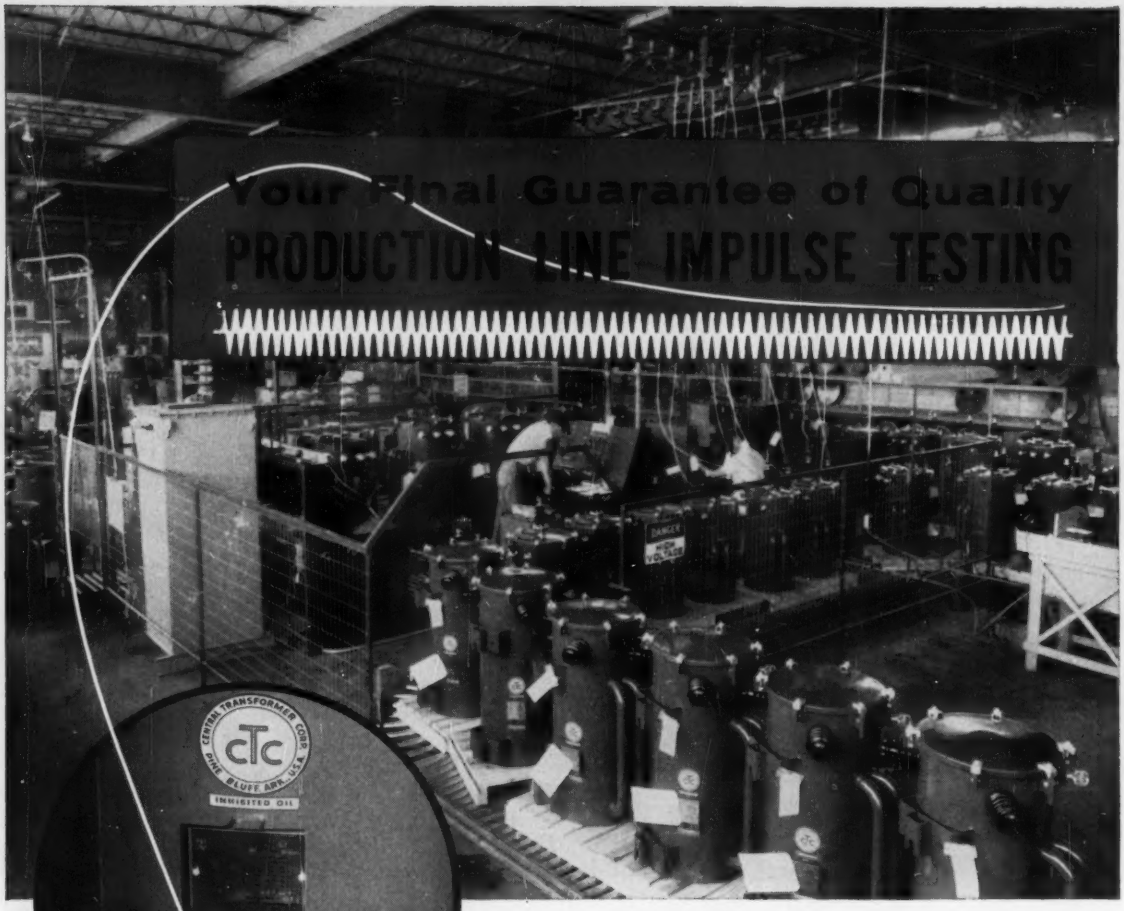

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Every Central distribution transformer, 100 KVA and below, is impulse tested on the production line. This – the last inspection step before shipment – is preceded by all standard NEMA and ASA tests. Precision manufacture and rigid inspection without premium costs are important reasons why more and more Central transformers are specified. Your inquiries are invited.

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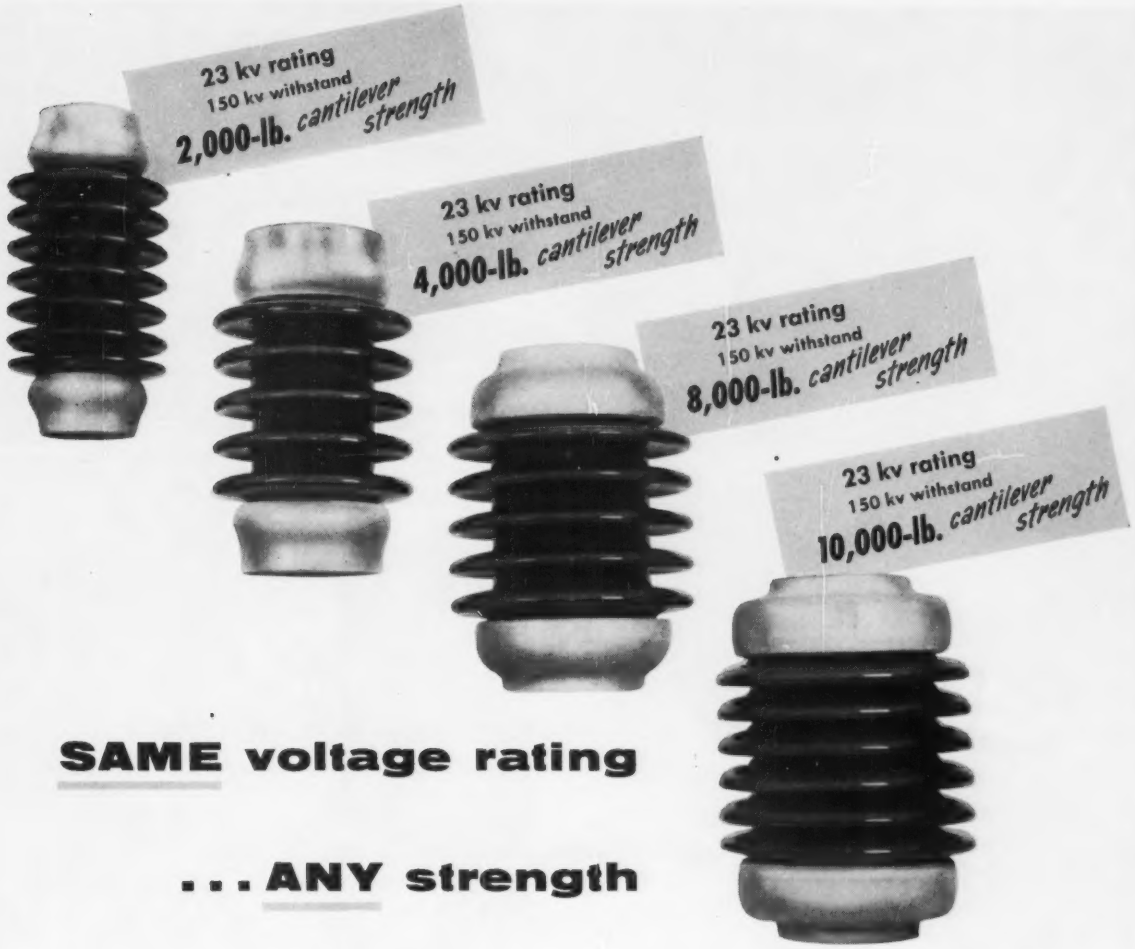
FROM THE SMALLEST TO THE LARGEST



SAME voltage rating

. . . ANY strength

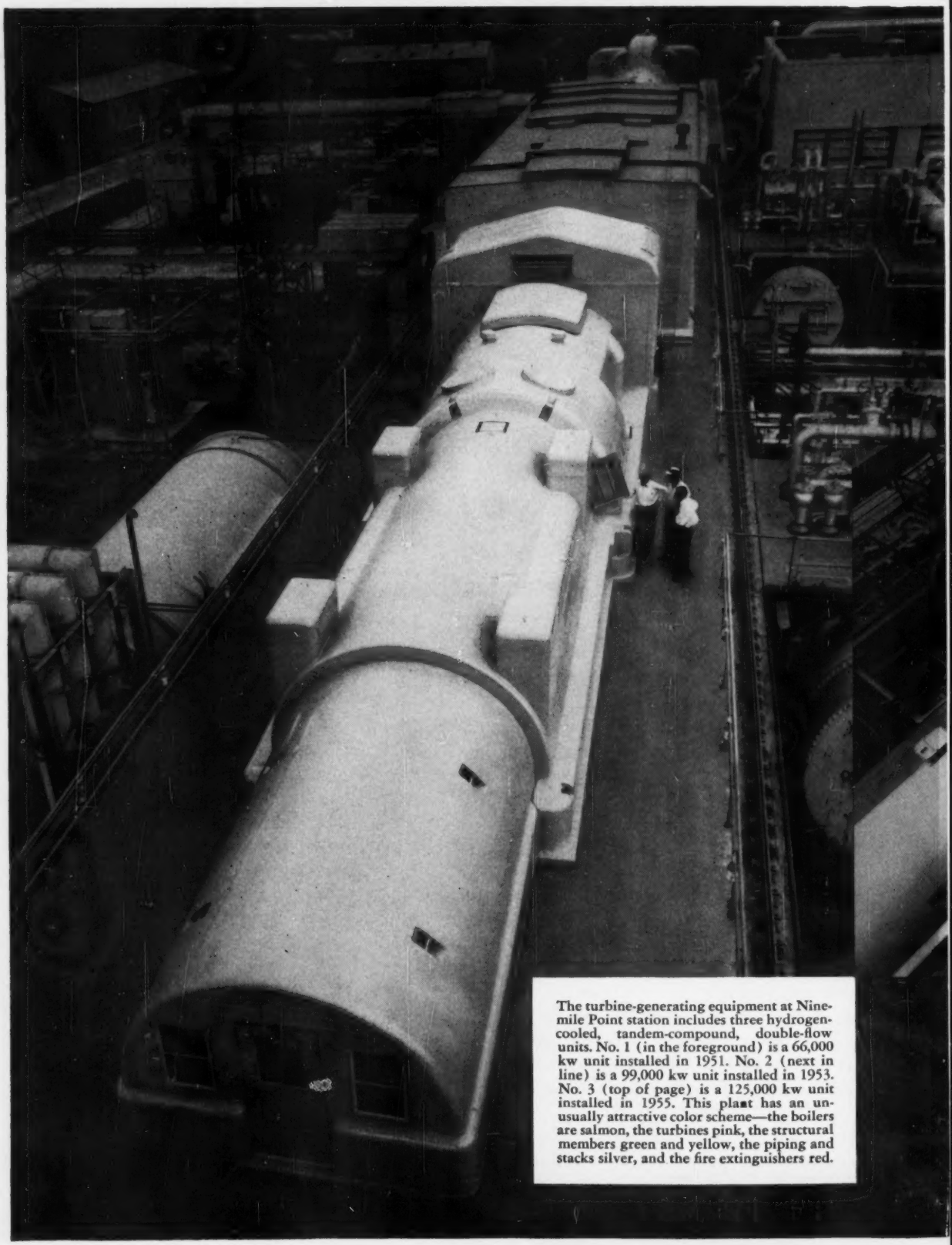
When substation design calls for buses to withstand high fault currents, there's often considerable economy in use of insulators of high cantilever strengths. Availability of such insulators affords freedom in structure design, and reduces total number of insulators and points-of-support required.

In the illustration above, the insulators shown are, in order, a Lapp Standard Station Post, a Lapp High Strength Station Post, a Lapp Extra High-Strength Station Post, and a "special" Lapp Station Post of still higher strength. It's "special" only because it doesn't happen to be in the most recent catalog, and because it doesn't fit any previously-established formal strength standards. A customer needed 10,000 lb. cantilever strength in a 23-Kv switch and bus insulator. He got it—in a hurry. If you need an insulator of such characteristics, specify it as Lapp No. 41398. If you need switch-and-bus supports in any other strength rating, we can probably make them, too. The merit of the Lapp Station Post design is reflected in the ease of its stress analysis. The simplicity of the post structure, the uniform reliability of Lapp porcelain, and the certainty of externally-attached caps—instead of pins or inserts—all are such that it is routinely possible to design an insulator into an unexplored strength field, without risk of unknown variables.

At any voltage rating, in any strength class, Lapp Station Posts give you an *extra* margin of operating security, low upkeep, long life.

Lapp Insulator Co., Inc., Le Roy, N. Y.

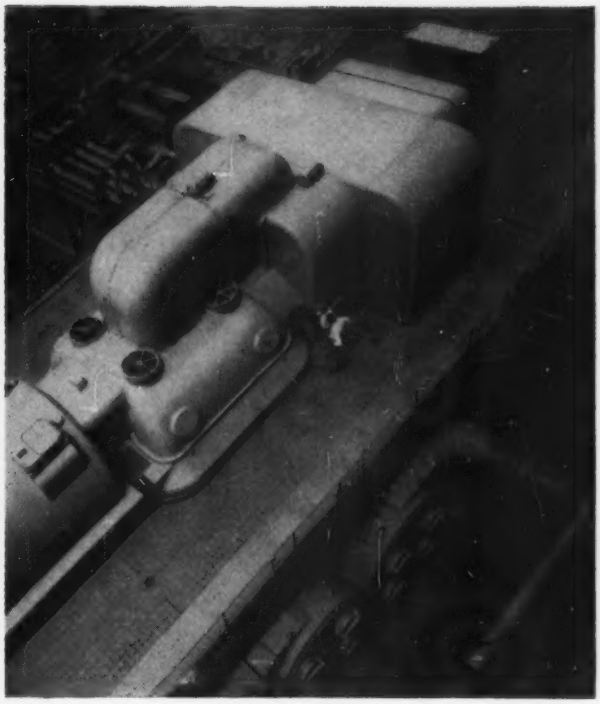
Lapp



The turbine-generating equipment at Nine-mile Point station includes three hydrogen-cooled, tandem-compound, double-flow units. No. 1 (in the foreground) is a 66,000 kw unit installed in 1951. No. 2 (next in line) is a 99,000 kw unit installed in 1953. No. 3 (top of page) is a 125,000 kw unit installed in 1955. This plant has an unusually attractive color scheme—the boilers are salmon, the turbines pink, the structural members green and yellow, the piping and stacks silver, and the fire extinguishers red.

Modern, efficient NINEMILE POINT plant uses the modern, efficient turbine oil:

GULFCREST



Close up of recently installed (1955) 125,000 kw turbine generator.

Pictured here are the turbine-generating units at the Ninemile Point station of Louisiana Power & Light Co., New Orleans, Louisiana, reported to be the most fully automatic utility power plant in the U.S.

For safe, sure, long-lasting protection of this key equipment, the lubrication is entrusted to Gulfcrest, the super-refined turbine oil.

After the base stock for Gulfcrest has gone through the usual steps employed in refining other turbine oils, it is processed by an extra refining step—the exclusive Gulf Alchlor Process—which produces a pure and stable lubricant that delivers unmatched performance.

The next time you fill a turbine system, make it a fill for the finest, longest lasting protection by specifying Gulfcrest, the world's finest turbine oil. An experienced Gulf Sales Engineer will recommend the proper grade to meet your specific requirements.

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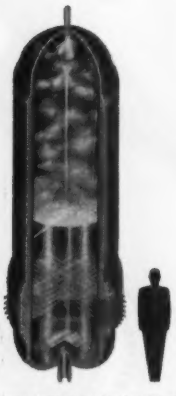
World's First Full-Scale Atomic Power Plant will be served by two FW steam generators and a large FW pressurizer



Cutaway drawing of Foster Wheeler electrically heated pressurizer for Shippingport Power Plant

Scheduled for completion in 1957, Duquesne Light Company's Shippingport plant is making rapid progress in construction, as shown by the photograph above. The two FW steam generators for this atomic power plant were shipped right on schedule, and were the first major components to arrive at Shippingport. The steam generators will convert heat from the nuclear reactor into steam for operating the turbogenerator. The nuclear reactor is being built by Westinghouse Electric Corporation for the U. S. Atomic Energy Commission.

Also to be supplied by Foster Wheeler is the 18-ft high, 300 cu ft pressurizer shown in section at left. Used to control coolant loop pressure, it is designed for 2500 psig at 675 F. There are 342 electric immersion heaters to supply energy for initial raising of the coolant system, as well as to control pressure during operation.

Foster Wheeler's nuclear know-how—in the design and construction of complete reactor systems or individual components—is available now, to assist in the planning of tomorrow's atomic power plants. For further information, write to *Foster Wheeler Corporation, 165 Broadway, New York 6, New York.*

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Jacketing of ALATHON® provides superior protection plus ease of installation

Jacketing of ALATHON® — for greater durability — for abrasion resistance
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Insulation of ALATHON® for heat resistance and higher dielectric strength

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Cable protected with ALATHON is light and easy to handle. Installation is speeded by its ease of pulling, cleanness in handling and simplified jointing and terminating requirements. Insulation and jacketing of ALATHON is tough and strong—has excellent abrasion resistance.

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there's a Commercial Filters unit engineered for your filtering job...

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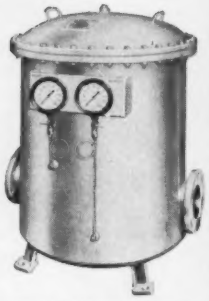

Fulflo Filters provide optimum clarity at ultra-high flow rates. For all industrial fluids—including oils, liquid fuels, chemicals, water, compressed air and various gases. Sizes to handle flow rates up to 1,600 gpm. Pressures to 4,000 psi.

Fulflo Filters feature Honeycomb Filter Tubes, the "precision controlled density" element that filters every drop again and again to give you microscopic clarity. Choice of cotton, acetate, nylon, orlon, dacron, dynel or glass fibres.

Standard models available in steel, stainless steel, rubber lined steel or nickel-plated brass. Custom models engineered to special requirements.

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Honan-Crane Filters offer "clean oil" filtration in diesel, turbine, hydraulic, metalworking and quenching operations. Bulk refill models provide depth filtration with cellulose medium for additive oils and Cranite (fullers earth) medium for straigth mineral oils. Multi-cartridge models feature six different types of cartridges that may be used interchangeably depending on type and degree of filtration desired. Flo-Pac models, installed in line, handle flow rates up to 900 gpm. All have quick-opening covers for ease in changing refills.

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Diesel and gasoline engines get complete protection against the damaging effects of dirty oil with Michiana Lube and Fuel Oil Filters. Designed for low cost filtration and proven in thousands of installations. "Throw-away" or repackable filter elements. Available in a wide range of sizes and models.

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This new, carefully developed method of color coding the individual conductors of multiple conductor cable results in superior quality, brighter colors and an extra tough coating for permanence.

Station, Traffic, Elevator and Railway control cables are color coded in accordance with IPCEA Standard color sequence and to customer's specifications.

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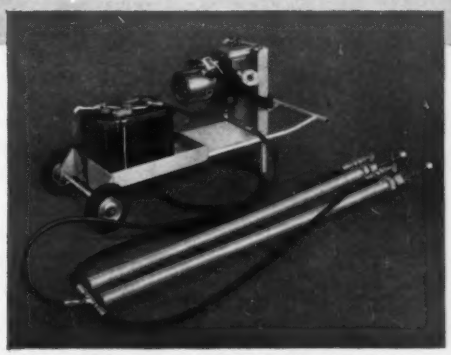
NOW Power-Operated Hydraulic Tank Lifter

Available for Allis-Chalmers intermediate breakers. Another example of Allis-Chalmers progress in simplifying maintenance while increasing safety. Costs no more than hand windlass type, yet cuts raising and lowering time by 80%.

Turning the needle valve completely controls operation and tank may be stopped in any position. Safe even if the hose or fittings are removed during operation.

Pressure energy is obtained from accumulator, power pump or hand pump of *Pneu-Draulic* system.

This is only one of many features of Allis-Chalmers all-new intermediate outdoor oil circuit breakers. Find out more by calling your nearby A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.



No *Pneu-Draulic* operator on your breaker? Battery operated hydraulic tank lifter is available. Same cylinder and flexible hose. Same operating characteristics.

Pneu-Draulic is an Allis-Chalmers trademark.

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ALLIS-CHALMERS

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NOW... you can obtain the advantages of the I-R UNIT-TYPE

Here's how the I-R Unit-Type rotor design contributes to dependable pump performance with minimum operating and maintenance expense.

HIGH EFFICIENCY— throughout years of operation

The simplicity of Unit-Type rotor design with precision-matched impellers and channel ring sections plus simple, direct fluid passages results in high operating efficiency. Efficiency stays high, too, because clearances are realistic and can be maintained without frequent replacement of wearing parts.

EASIER MAINTENANCE— and less of it

The Unit-Type rotor permits quick and easy removal of the entire rotor assembly without disturbing suction and discharge connections. All parts of the assembly are readily accessible, and easy to remove and reassemble. There are no shrink fits or delicate alignment problems.

GREATER INTERCHANGEABILITY— smaller spare parts inventory

Maximum interchangeability of rotor-assembly parts makes it unnecessary to stock separate replacement units for each individual stage. Except for the suction and discharge stages, impellers and channel rings are completely interchangeable.

SYMMETRICAL CASING— for greater strength

Unit-Type rotor assembly eliminates intricate hydraulic passages in the casing. The symmetrical casing provides greater strength, minimizes thermal distortion, and permits an attractive, streamlined exterior appearance.

FLEXIBILITY OF DESIGN— permits changes in operating conditions

Changes in operating conditions can be met easily by installing a new combination of impellers and channel rings on the original shaft...in the original casing. Forseeable changes in operating conditions can also be met by using "dummy" stages which can later be replaced by complete working assemblies. Unit-Type rotor design and smooth bore casing makes this possible.

FOR FURTHER INFORMATION— see your nearest I-R representative

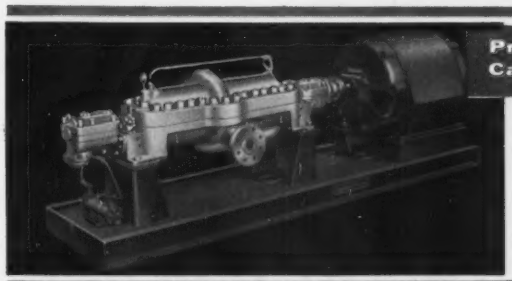
Your local I-R Sales Engineer will welcome the opportunity to work with you in the selection of boiler-feed pumps best suited to your requirements. Ask him to tell you about the latest advances Ingersoll-Rand has made in pumps for condenser circulating, condensate, heater drip and other power plant and central station services.

Ingersoll-Rand

10—440 **11 Broadway, New York 4, N. Y.**

ROTOR ASSEMBLY

in a complete line of boiler-feed pumps for pressures from 300 to 6500 psi

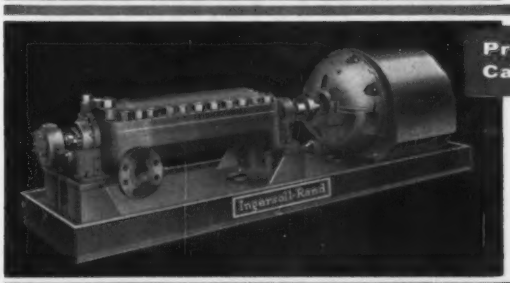


Pressures: 300 to 1000 psi
Capacities: to 700 gpm

Class CNTA

Recommended for medium pressure installations, the Ingersoll-Rand Class CNTA is today's most modern and efficient multi-stage boiler-feed pump in its pressure class.

It has a smooth-bore, symmetrical casing and features opposed impeller groups to neutralize axial thrust. Bearings can be either sleeve- or ball-type.

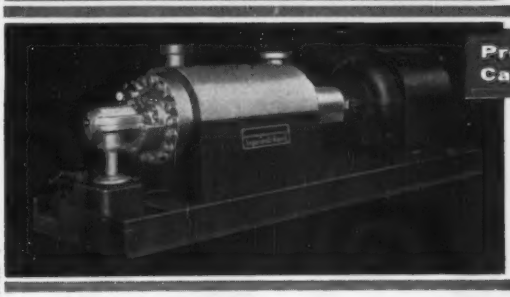


Pressures: to 1200 psi
Capacities: to 1600 gpm

Class HMTA and HMTB

I-R Class HMTA and HMTB multi-stage centrifugal pumps feature a symmetrical, horizontally-split casing and "in-line" staging.

Supplied in from 3 to 9 stages, they are widely installed as boiler-feed pumps in central stations and industrial plants. Ball- or sleeve-type bearings are available.



Pressures: to 6500 psi
Capacities: to 2800 gpm

Class CHTA and CHTB

Of the double-case design, Class CHTA and CHTB multi-stage centrifugals consist of a vertically-split inner assembly enclosed in a heavy cylindrical outer casing.

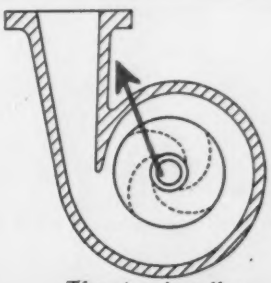
More of these Ingersoll-Rand pumps are installed in high-pressure boiler-feed service than any other make—indisputable proof of their overwhelming acceptance by modern central stations.

Thrust forces balanced with multiple-volute design

COMPLETE RADIAL BALANCE—a feature of all these I-R boiler-feed pumps

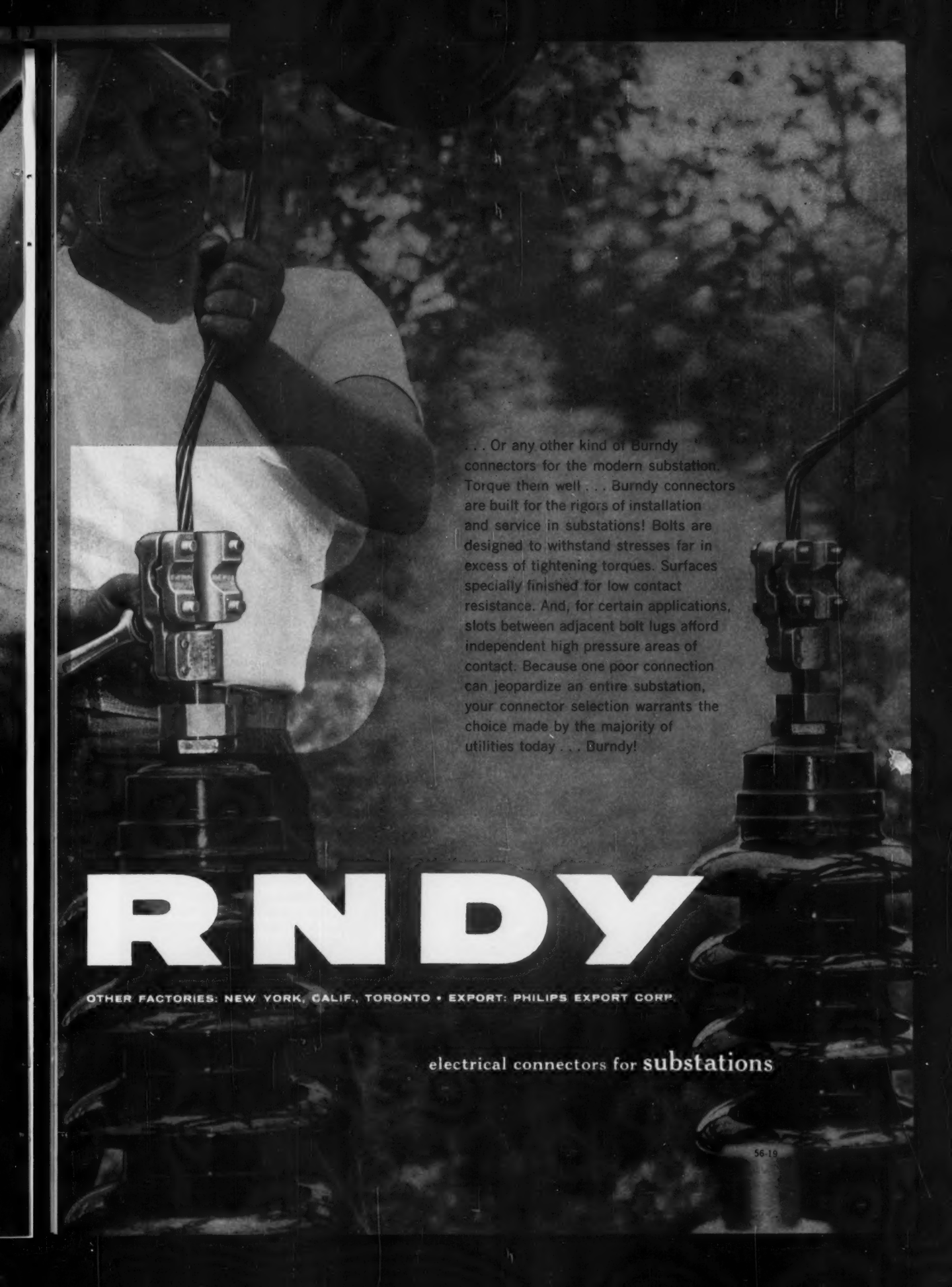
Evenly spaced volute passages around the entire circumference of the impeller balance the radial thrust force. That is, the radial forces become equal in all directions with a zero resultant on the impeller.

With a single volute casing, a radial thrust force is created due to the uneven pressure distribution around the periphery of the impeller. This force tends to deflect the shaft and cause the rings to rub with a loss in efficiency.



Thrust on impeller unbalanced in single volute design

let's "torque"...stud connectors!
BU
NORWALK, CONNECT.

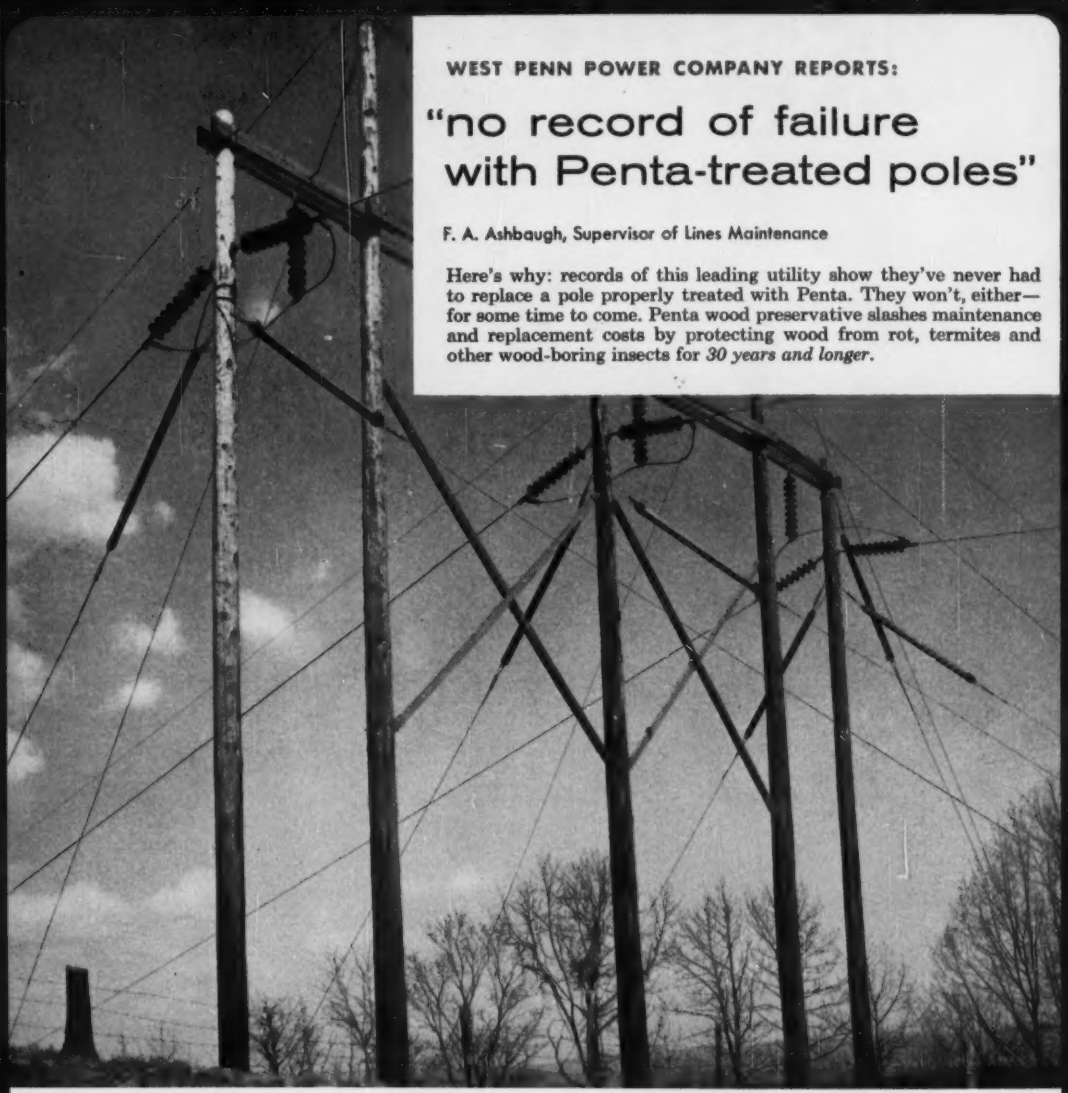

. . . Or any other kind of Burndy connectors for the modern substation. Torque them well . . . Burndy connectors are built for the rigors of installation and service in substations! Bolts are designed to withstand stresses far in excess of tightening torques. Surfaces specially finished for low contact resistance. And, for certain applications, slots between adjacent bolt lugs afford independent high pressure areas of contact. Because one poor connection can jeopardize an entire substation, your connector selection warrants the choice made by the majority of utilities today . . . Burndy!
RNDY
OTHER FACTORIES: NEW YORK, CALIF., TORONTO • EXPORT: PHILIPS EXPORT CORP.
electrical connectors for substations
56-19

WEST PENN POWER COMPANY REPORTS:

"no record of failure with Penta-treated poles"

F. A. Ashbaugh, Supervisor of Lines Maintenance

Here's why: records of this leading utility show they've never had to replace a pole properly treated with Penta. They won't, either—for some time to come. Penta wood preservative slashes maintenance and replacement costs by protecting wood from rot, termites and other wood-boring insects for *30 years and longer.*



"All the wood elements of this structure in Westmoreland County, Pa.,—crossarms, X-braces and guy insulators—are Penta-treated. In 16 years we've had no record of failure of poles properly treated with Penta," says Supervisor Ashbaugh.

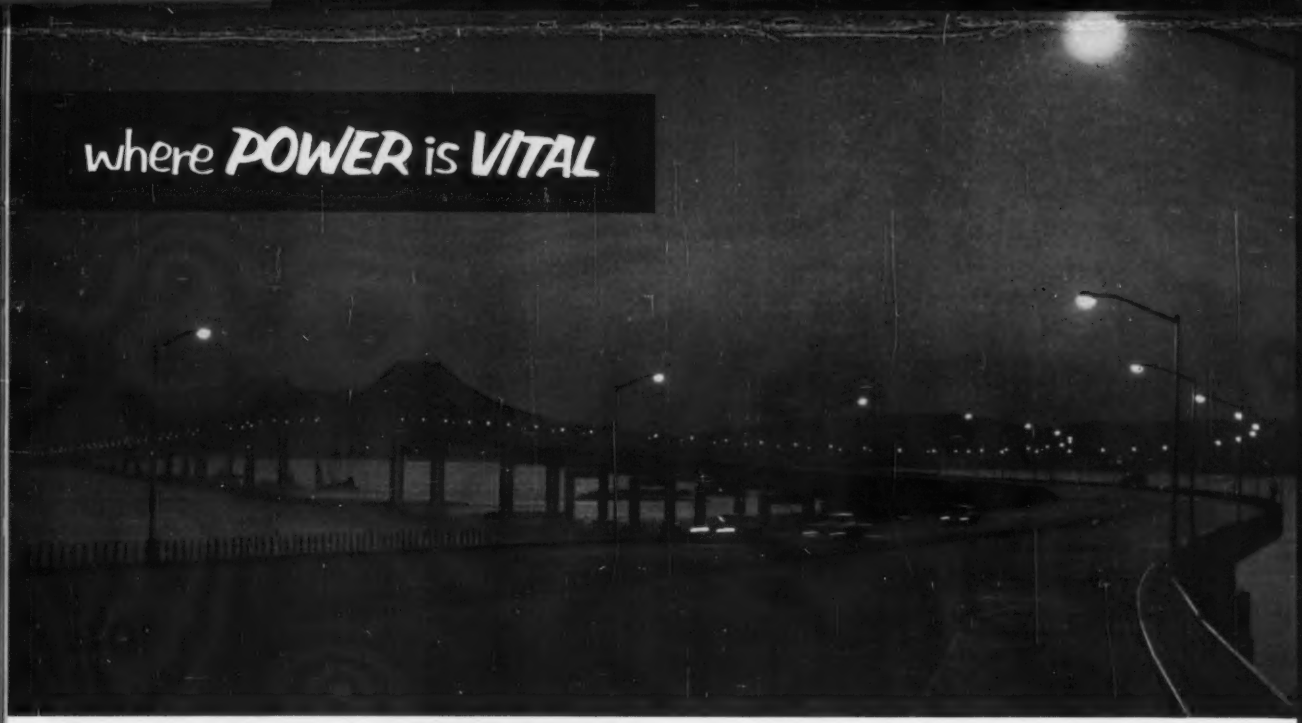
"Our employees like the cleanliness of Penta-treated lumber." And well they might! Clean Penta-treated poles don't burn hands or stain clothes. Installations are faster, easier.

You can measure Penta protection easily, accurately. When increment borings from a Penta-treated pole are chemically analyzed, you know how much Penta remains in the wood at any given time.

FOR A FREE COPY OF "Penta for Poles and Crossarms," write Organic Chemicals Division, MONSANTO CHEMICAL COMPANY, Dept. PI-12, St. Louis 1, Mo.

MONSANTO

Where Creative Chemistry Works Wonders For You



Night traffic on the Tappan Zee Bridge, New York State Thruway

ASCO TRANSFER SWITCHES help assure safe lighting on America's highways . . .

Where nightfall and fog can spell death on the road, lighting is vital. That is why construction engineers today insist upon a continuous supply of adequate road-light power, insist upon standby systems which can immediately take over in case of local power failure. They specify ASCO . . . because ASCO Transfer Switches *can be depended upon* to make automatic transfer to emergency in split seconds.

Dependable Control by ASCO

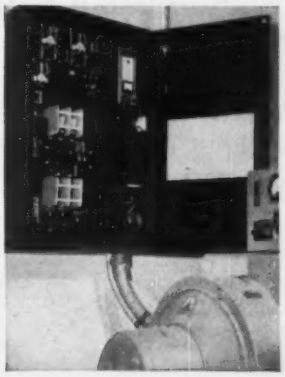
Because of this dependability, ASCO Transfer Switches have been specified to help maintain adequate lighting at key points along the traffic-heavy New York State Thruway. Likewise in power, lighting, heating, communications, marine, machinery, transportation and a wide range of industry, ASCO dependable switches supply essential insurance when normal power fails.

Check these advantages of ASCO Transfer Switches . . .

- *continuous duty rating* in either normal or emergency position
- *capacity* to withstand inrush currents 20 times full load rating
- *mechanical locking*, providing sure contact pressure
- *single coil design*
- *built-in time delay*, so that equipment ignores harmless momentary outages
- *accessories* to meet your specific requirements
- *full phase protection* and other design features

Write for Booklet 596 describing how to select an adequate automatic transfer switch.

Typical toll gate at Harriman. Its emergency power for lights and equipment also depends on ASCO Transfer Switches



Actual ASCO switch at Harriman showing International Fermont emergency generator. On power failure, load is transferred by Automatic Transfer Switch, Bulletin 905, and then retransferred when normal supply is operating.

Important announcement . . *new ASCO plant in Florham Park, N. J., doubles production capacity and greatly extends range of our research, product development and services.*

Automatic Switch Co.

397 Lakeside Avenue, Orange, N. J. • ORange 2-5300

ASCO®

"We had as many as 24 Solenoid coils a month burn up before we installed BUSS FUSTATS" . . .

"Now our burned up coil losses are negligible."

C. R. Babcock, CHIEF ELECTRICIAN
DEWEY PORTLAND CEMENT CO. DAVENPORT, IOWA

Mr. Babcock continues ——

"The burning up of the solenoid coils that activate the plungers that dump our weighing scales was a real problem with us. We lost as many as 4 coils on one 8 hr. shift. The maximum was about 24 coils a month.

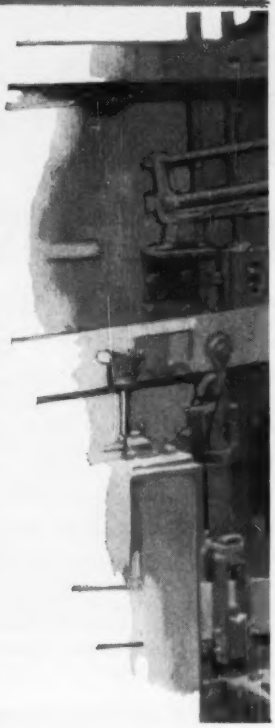
"Trouble develops on the days when the gypsum for our cement picks up moisture and sticks to the scales. Then the counterbalance can't reset the scale and, as a result, the plunger moves up and down energizing and de-energizing the thrust coil. The coil has only a few turns of large copper wire and draws a heavy current each time it is energized. It heats up quickly and burns up.

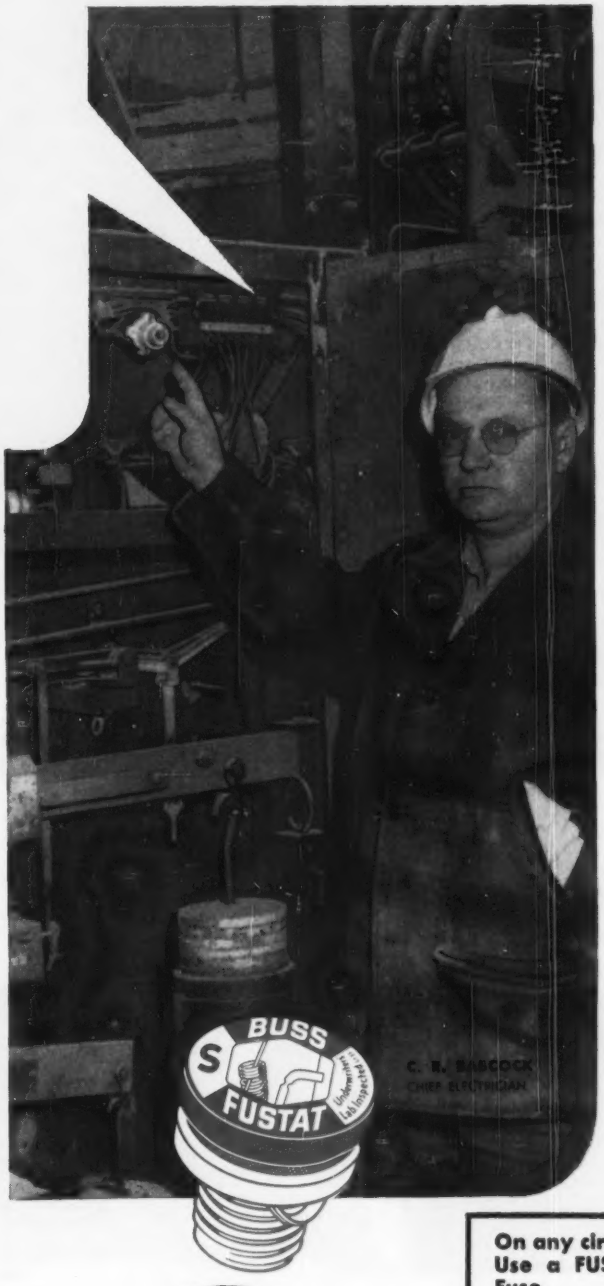
"To give over-load protection to the thrust coil, which is on a 125 volt DC power supply, we installed a 3.2 BUSS Fustat in a series with the coil. (BUSS Fustats are FUSETRON dual-element fuses with a type S base for use on circuits up to 125 volts.)

"Now, when there is trouble the Fustat opens before the coil is damaged. The scale is cleaned and another Fustat installed. We are then back in operation.

"We have three of these scales and at the present time we are replacing only about one coil a month and this is generally due to mechanical and moisture damage.

"We figure BUSS Fustats save us money in two ways — by practically eliminating the cost of replacing solenoid coils — and by greatly reducing our down-time losses."





On circuits of 125 volts or less —

The Proper Size BUSS Fustat can Reduce Danger of Burnout of Solenoids, Coils, Transformers and Motors

A BUSS Fustat is a Fusetron dual-element fuse with a type S base for use on circuits of 125 volts or less. A Fustat gives all the protection of a fuse against short-circuits or dangerous overloads — yet, it permits circuit to be loaded safely to maximum capacity.

Protecting Solenoids, Coils and Transformers —

By installing the proper size Fustat, a solenoid can be protected because the Fustat will not open on the operating surge but will open in time to protect, should the heavy current continue too long for any reason.

A transformer or coil, likewise, can be protected because the long time-lag of the Fustat permits it to hold all normal current surges and harmless overloads — yet it will open to prevent burnout on any dangerous overloads.

Protecting Motors against burnouts —

A BUSS Fustat of motor-running protection size mounted anywhere in the circuit to handle ONLY the motor current will give finest available protection against burnout of the motor.

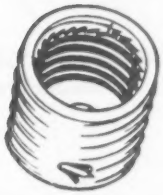
Nothing else is needed. Underwriters' Laboratories listing gives Fustats same degree of approval for both motor-running and short-circuit protection as the most expensive devices made.

BUSS Fustats stop dangerous practice of tampering or overfuseing

The type S (tampering resisting) base of a Fustat prevents anyone replacing them with an ordinary fuse, a penny or other substitute — or with a size too large to protect.

Fustats fit ordinary Edison base fuse holders through use on an inexpensive adapter that once installed need never be replaced.

Write for bulletin SMPS.



On any circuit up to 600 volts — Use a FUSETRON dual-element Fuse.

Fusetron fuses protect motors, solenoids, coils and transformers against burnout; they offer maximum safety because of their 100,000 amp. interrupting rating; they help increase production by eliminating needless blows and they cut maintenance costs because they are maintenance free.

Write for bulletin FIS . . .

For loads above 600 and up to 5,000 amps. — Use BUSS Hi-Cap Fuses.

When coordinated with Fusetron fuses they will not open ahead of the fuse nearest fault . . .

Write for bulletin HCS.

Play Safe! **Install BUSS Fustats, FUSETRON Fuses and BUSS Hi-Cap Fuses throughout entire Electrical System!**

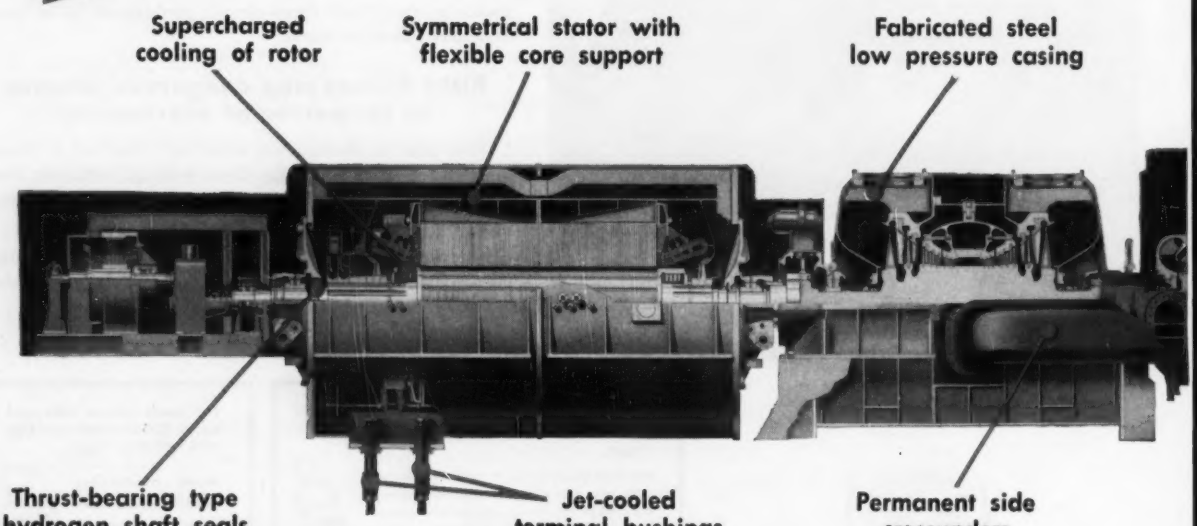
Bussmann Mfg. Co. (*Division of McGraw Electric Co.*)
University at Jefferson, St. Louis 7, Mo.

1056

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

CAPACITY of this station has been raised to 270,000 kw by the installation of an Allis-Chalmers 100,000-kw turbine-generator. The new unit makes the station one of the largest in the area.

Here's MORE Power


Supercharged cooling of rotor
Symmetrical stator with flexible core support
Fabricated steel low pressure casing
Thrust-bearing type hydrogen shaft seals
Jet-cooled terminal bushings
Permanent side crossunders

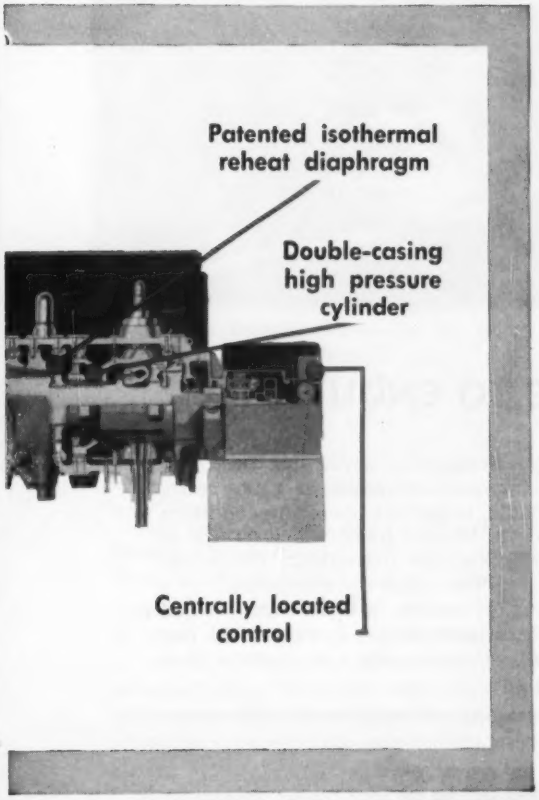
A-C ALLIS-CHALMERS

ALLIS-

STEAM CONDITIONS for this 100,000-kw turbine are 1450 psig, 1000 F inlet, 1000 F reheat, 1.5 inch mercury absolute exhaust. Generator rating is 133,689 kva, 0.85 pf, 13,800 volts, 0.64 short-circuit ratio, at 30 psig hydrogen pressure.

Pioneer Service & Engineering Co., consulting engineers

Pioneering



New 100,000-kw reheat unit in midwestern utility combines side-crossunder, tandem-compound steam turbine with supercharged hydrogen-cooled, 3600-rpm generator.

To meet present and future requirements, this modern Allis-Chalmers turbine-generator combination went into operation recently in a large midwestern utility power plant.

Typical of Allis-Chalmers tandem 3600-rpm reheat turbines for ratings of 75,000 to 250,000 kw, this 100,000-kw unit joins others already proved in operation.

You can continue to look to Allis-Chalmers for MORE pioneering of turbine-generator units engineered to your requirements — up to 500,000 kw. For more information, contact your nearby A-C representative, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

A-4985

CHALMERS

Alexander the Great, who, before he was 30 conquered almost all the known world, was history's hardiest character. Schooled by Aristotle, conditioned to endure unbelievable extremes of cold, heat, hunger and thirst, Alexander, though always outnumbered in battle, always triumphed.

GREAT... when it comes to endurance

Alexander the Great's physical endurance was legendary, well-nigh superhuman. Toughness and resistance were vital in Alexander's time . . . and they are today, too—in the cables that serve as the nerve system of transportation, power and industry.

Moisture, heat, cold, deteriorating elements, time itself—all combine to make inroads on cable installed underground, under water, or exposed to the air.

Kerite is designed to withstand these conditions—for years. Incredible as it may seem, Kerite Cable, in perfect operating condition after 30, 40, 50 and more years service in rugged applications throughout the world is the *rule* rather than the exception.

Nothing, of course, lasts forever . . . but Kerite lasts indefinitely. It represents one of the wisest investments in *service* that can be made.

The value and service life of a product can be no greater than the integrity and craftsmanship of its maker.

Founded 1854

KERITE CABLE

THE KERITE COMPANY—30 Church St., New York 7, N. Y.
Offices also at 122 S. Michigan Ave., Chicago; 582 Market St., San Francisco;
3901 San Fernando Rd., Glendale 4, Calif.; 31 St. James Ave., Boston

EDITORIALS

Survey Reveals Trends in Steam Station Design

If there is any glamor in the utility business, generation certainly contributes its share. Outdoor design, supercritical operation, and nuclear power, to mention a few, are developments that have captured the imagination of the public as well as of utility engineers. These will be recognized as turning points in power generation.

But equally important, although not nearly so spectacular, are the many smaller advances contributed by plant equipment manufacturers and designers. Electrical World's Steam Station Design Surveys have recorded these improvements large and small since 1950. Each survey has disclosed new trends and the refinement of others until the trend of the past becomes standard design practice.

The First Steam Station Design Survey eight years ago for example, did not record use of demineralizers for feedwater purification. But today's survey discloses that demineralization is used for purification more than all other processes combined. During the intervening years this equipment has gradually won industry acceptance.

The 4th Steam Station Design Survey (p 143) discloses the latest in design practices. Like its predecessors it covers new design trends. Size and, to some extent, pressure are mainly responsible for these design departures. With bigger units already in prospect, the immediate future will bring many more innovations.

Already some designers contemplate changes in supplying boiler feed pump power. It is no longer just a question of supplying a larger motor. Nonmotor drives must be considered. The whole question of auxiliary power must be re-evaluated. And unit design will face its biggest test as the swing to the bigger unit makes designers stop and wonder whether they should put all their eggs in one basket. The years ahead will bring continued change in station design. It is obvious in the results reported in this issue.

Higher Price Coal Aids Nuclear Power

Recently the atomic power plant got another boost. The newspapers concealed the story in one about the soft coal miners getting a $2.40 a day raise. They didn't say that this would mean another boost in coal prices. And every time the price of coal or oil or gas goes up the effect is the same as if the cost of generating power in a nuclear plant were brought down—the big differential in fuel costs is being narrowed.

Of course the expected rise in coal prices will not make the nuclear plant competitive with the conventional steam plant. But our scientists are certain to reduce the present high cost of operation as nuclear plants go on the line and experience is gained in their design, construction and operation.

To the electric utility industry the use of a few pounds of uranium or thorium instead of thousands of tons of coal is becoming more alluring day by day.

Our Children Deserve Better Schools

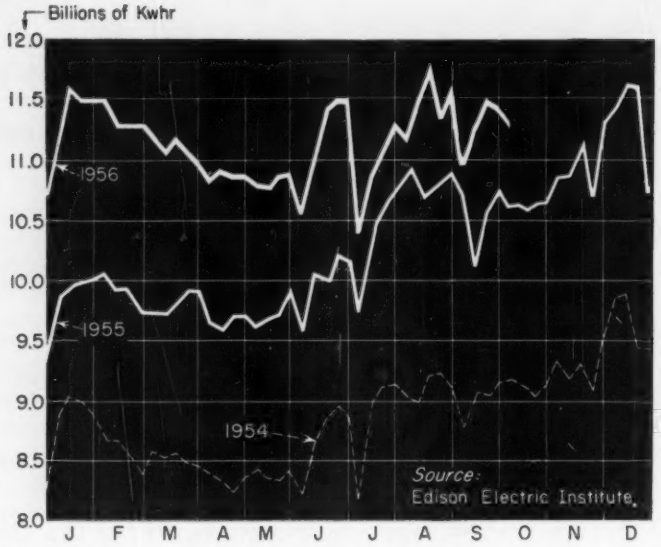
Two short sentences in a recent advertisement in Electrical World (Sept. 3, p175) were the greatest indictment of the electric utility industry that this magazine ever carried. The sentences: "One quarter of all American high schools offer no chemistry or physics. One quarter offer no geometry." These sentences indict the power distributors where these substandard schools are located whether they be private power companies, cooperatives, or municipal electric systems.

Communities today look to the local power distributor to promote the development of their areas. Good schools are important to this development. Schools that practically bar their graduates from studying engineering and science in college can only be classified as bad.

Furthermore, in many communities utility engineers are the only engineers. Unless these men take an active interest in assuring that local high school graduates are prepared to follow in their footsteps, the industry loses, the children lose, and the country loses.

Don't Fail to Vote

ELECTRICAL WEEK



OUTPUT

Week ended Oct. 6
11,342,000,000 Kwhr
Up 6.6%

Atomic Energy Commission requirements—1,125,000,000 kwhr (Electrical World estimate). Excluding AEC, output increase was 6.2%

Per Cent Change From Previous Year

	Total US	New Eng.	Mid. Atlan.	Cent. Ind.	West Cent.	South-east	South Cent.	Rocky Mount.	Pacific NW	Pacific SW
Oct. 6	+6.6	+5.3	+4.4	+5.8	+7.2	+6.2	+9.3	+11.4	+7.6	+9.2
Sept. 29	+6.9	+7.9	+5.5	+7.7	+8.1	+5.5	+6.9	+9.4	+5.2	+8.8
Sept. 22	+6.7	+7.2	+4.3	+7.1	+5.6	+5.1	+11.8	+8.7	+6.9	+9.0

Seasonally Adjusted Index 218.0 Week Ago 218.2 Year Ago 204.3

Here are the issue's highlights . . . Rural Co-ops lose their "crusade appeal" . . . AEC to hold its first public hearing regarding PRDC's proposed reactor near Detroit, the safety of which is questioned . . . Carolina and Virginia utilities create atom-power company . . . Fred Seaton stumps for Ike's power policies, particularly in Far West . . . Collapse of office building in Jackson, Mich., kills 10 construction workers . . . "Unnecessary" substation accident takes Pacific P&L man's life . . . Earl Chudoff gets an earful at Roseville, Calif., hearings . . . Calder Hall dedicated.

Idaho Power Co wins another round against public power foes as U. S. Circuit Court of Appeals denies the petition request of National Hells Canyon Association and other groups to suspend permit granted by FPC for Idaho Power's construction of three low dams in Hells Canyon region of the Snake River. Opponents, favoring a federal single high dam, now plan a petition to U. S. Supreme Court for a writ of certiorari on Circuit Court's decision.

Forty-four electric utilities set up storm warning network. The communications network blankets every major population center and will permit utilities to quickly exchange weather and damage information as storms, hurricanes, and other disturbances pass from one area to another.

Coal prices climb 40¢ a ton at northern mines. Increase follows new coal labor agreement which raised wages and fringe benefits by $1.60 a day. Pittsburgh Consolidation Coal, major soft coal producer, has set its prices at $4.80 a ton in West Virginia area (see Electric Business Outlook, p 19).

Frigidaire lines up behind "Live Better . . . Electrically" with introduction of its own nationwide LBE campaign at a company distributors meeting today. Move now puts all full-line appliance makers behind program, says LBE.

NEWS OF THE INDUSTRY BRIEFLY TOLD

Washington Wire . . . Securities & Exchange Commission names Philadelphia's Daniel J. McCauley, Jr, as associate general counsel. He succeeds Bruce L. Carson who resigned . . . **Ohio Power seeks SEC approval** to issue and sell to its parent American Gas & Electric 110,000 additional common shares for $11 million.

Pool-type plan for Rio Grande project is agreed on by Bureau of Reclamation and four Southwestern utilities—Community Public Service, Plains Electric Generation & Transmission Co-op, PS of New Mexico, and El Paso Electric. Project has 24,300-kw hydro plant and a transmission network.

New England electric utilities slate $6-billion expansion program between 1946 and 1980 to boost generating capacity from today's 5,542,000 kw to 17,500,000 kw in 1980, discloses Irwin L. Moore, president, New England Electric System.

Three more electric companies join Edison Electric Institute, giving it a 95% coverage of all customers served by investor-owned companies.

Under Secretary of Interior Clarence A. Davis will resign his government post about Jan. 1 to return to private law practice. Hatfield Chilson, attorney for the Colorado State Water Conservation Board, may succeed Davis.

Alabama Power Co seeks Alabama Public Service Commission permission to build two Warrior River projects—a 160,000-kw generating plant at Upper New Hope and a 45,000-kw generator at John Hollis Bankhead Dam (Lock 17).

English Electric Co temporarily lays off about 50 office production employees, members of United Steel Workers Local 4850, as result of shortage of work following strike of plant employees Sept. 24.

Because Massachusetts and New Hampshire "have been dilatory in pursuing their requests for St. Lawrence power", they will be omitted from N. Y. State Power Authority's recently announced plans to proceed with marketing of the river's power, said Authority Chairman Robert Moses. Vermont, which lies within the "economic marketing area" will be allotted 100,000-kw.

ABOUT PEOPLE IN THE INDUSTRY

"There is no give-away when tax-paying private enterprise develops the natural resources of this country and puts them to work for the benefit of all the people in the area," **Walter H. Sammis, president, Ohio Edison Co,** told the Kiwanis Club of Akron. "The real give-away occurs when the Federal government itself builds and operates power plants with the tax monies . . . and then sells the electricity at less than its real cost. . . ."

"We must re-examine the preparation of our line executives for more general executive leadership," declared **George S. Dinwiddie, president, Southeastern Electric Exchange,** speaking before the SEE Sales Conference in St. Petersburg, Fla. The utility executive went on to say, "Individual specialized thinking among salesmen, engineers, and others in utilities must be expanded to encompass wider problems of our industry."

More News About People page 264

AEC Slates Reactor Hearing

Power Reactor Development Co's proposed breeder reactor plant will be studied for safety hazards at request of unions

For the first time in its history, the Atomic Energy Commission will hold a public hearing Nov. 13 on its approval of a proposed nuclear power plant.

AEC announced last week that it would grant the petitions of three labor unions for a hearing involving the proposed fast breeder reactor of Power Reactor Development Co outside Detroit.

AEC, which has no hearing examiners of its own, asked Jay A. Kyle, assistant chief hearing examiner for the Federal Communications Commission, to conduct the hearing.

Kyle, however, will make no ruling. He will merely certify the record. The AEC will then make its own decision. This differs from procedure followed by the Federal Power Commission and other regulatory commissions under which examiners make recommended decisions.

The United Auto Workers, International Paper Workers, and International Electrical and Radio Workers Unions had petitioned AEC for the hearing following strong criticism by some members of Congress of the AEC for issuing a construction permit to PRDC.

In making their petitions, the unions also asked for an immediate halt of construction. AEC denied this. But the hearing will probe PRDC's financial ability to undertake the project.

PRDC's present troubles started with a safety report issued by the AEC advisory committee on reactor safeguards last June. This report, now made public for the first time, held that "there is insufficient information available at this time to give assurance that the PRDC reactor can be operated at this site (Lagoona Beach) without public hazard."

The report further questioned whether enough information would be available to permit safe operation by the time the reactor is ready.

Recognizing the safety questions involved, AEC therefore made its preliminary construction permit conditional upon PRDC's resolving these safety matters. AEC stated emphatically it would not convert the permit to an operating license until this condition was met.

The PRDC group, headed by Detroit Edison Co's Pres Walter L. Cisler, broke ground for the project Aug. 8. Company officials are sure they can lick the safety problems.

AEC has ordered specifically that the hearing must determine these issues:

- Whether there is sufficient information to assure that the proposed project can be operated without risk to the health and safety of the public.
- Whether there is assurance that technical information omitted from the PRDC application will be applied.
- Whether PRDC is qualified financially to undertake the project.
- If the proceeding decides in favor of continuing construction, what changes, if any, should be made in the construction permit.

4 Southern Utilities Form Atom Power Group

Four major power companies serving most of the Carolinas and Virginia have revealed that they jointly will undertake to establish a nuclear power generating plant to produce electricity commerically, and also to serve as a pilot plant for experimental work.

Participating in the project are Carolina Power & Light Co of Raleigh, N. C.; Duke Power Co, Charlotte, N. C.; Virginia Electric Power Co, Richmond, Va.; and South Carolina Electric & Gas Co, Columbia, S. C.

The charter for Carolinas-Virginia Nuclear Associates, Inc, as the new group will be known, provides for the corporation to "design, develop, fabricate, construct, and operate a nuclear power reactor or reactors."

Officers of the new corporation are: N. A. Cocke, (president of Duke Power) president; Louis V. Sutton (president and chairman of the board of Carolina P&L), vice president; S. C. McMeekin (president of South Carolina Electric & Gas), vice president; T. Justin Moore, (chairman of the executive committee of VEPCO) vice president; and J. N. Costello, (chairman of the executive committee of VEPCO) secretary-treasurer.

Cocke, Sutton, McMeekin, and Moore also were elected directors of the new corporation, as were H. B. Robinson, vice president of Carolina P&L; F. R. McMeekin, vice president of South Carolina E&G; Erwin H. Will, president of VEPCO; and O. J. Miller, vice president of Duke Power.

Headquarters will be in Charlotte. The first meeting of the directors is slated for Oct. 17 in Richmond, when scientific personnel to be employed will be considered. It is planned to employ a group of physicists and scientists to study the five basic types of reactors and decide which offers the most to the new corporation.

No information is available yet regarding size and cost of the project, and no target date for construction of the plant has been set. Cocke said selection of a site for the plant will be "largely a matter of engineering." But there have been suggestions that it be situated in North Carolina because of the state's central location in the three-state area—possibly near Charlotte or Raleigh.

"We are ready to undertake a reactor program which will afford us a practical working knowledge of design, installation, and operation," Sutton said. "We believe our investment will be justified. As we gain practical operating experience, we may later undertake individual reactors of our own."

Another spokesman said any power generated would be put on a line, underscoring that the project at present is "developmental" not "experimental."

Seaton Stumps for GOP Policies

. . . particularly in Far West where Republicans stand to gain most. The Interior Secretary symbolizes the type of Republican party that Eisenhower seeks

Among the members of President Eisenhower's cabinet who have taken the campaign trail to promote Administration policies, few are doing a more effective job than Interior Secretary Fred A. Seaton.

Seaton is concentrating his campaign in areas where the Republicans stand to gain most—in the Far West where Former Secretary Douglas McKay's policies on handling natural resources are under heaviest fire. Frequently singled out as the type of Republican Eisenhower is trying to rebuild the party around, the 47-year-old Seaton perhaps can turn the Administration's policies in the field of natural resources into assets, if anyone can.

The hard-driving Secretary is just back from his second tour of Far West states, capping it off this week with a speech before the National Press Club in Washington, one of the nation's most coveted speaking forums. In the Press Club speech, Seaton spoke as a cabinet member addressing himself broadly to the Administration's record, while on his western swing he confined himself to power policy and the handling of natural resources.

Seaton Is Non-Controversial

Seaton's main political asset is that he has succeeded in remaining noncontroversial in what has usually been a highly controversial post. His predecessor, McKay, now running for the Senate seat of Sen Wayne Morse in Oregon, is a mild-mannered, gregarious type who none-the-less succeeded in drawing a steady barrage of Democratic artillery for his policies until he quit to run for the Senate.

Seaton first spent a week in Oregon, moving around the state, making off-the-cuff speeches, talking to local groups who were seeking federal assistance on project development. Then he returned to the west coast and spent a week primarily in Washington, giving a lift to Gov Arthur Langlie who reportedly is running behind Sen Warren Magnuson in one of the nation's hottest Senate races.

Seaton covered the Columbia Basin area and then wound up with a speech at Las Vegas, Nev., in an effort to give a hand to Rep Cliff Young's attempt to unseat Sen Alan Bible.

In the Columbia Basin area Seaton told the groups he met with that power policies of the Eisenhower Administration have encouraged initiative in the Northwest and cited power gains. Seaton compared non-federal projects licensed and started in the four years prior to Eisenhower to those licensed and started since Jan. 20, 1953.

More Projects Under GOP

Sixteen projects in Pacific Northwest with a capacity of 1,110,500 kw were started under the Truman Administration, Seaton pointed out. This broke down to 540,000 kw for public agencies—state, local PUD's and municipalities, and 570,000 kw for private utilities. Since Eisenhower became president, Seaton said, 13 projects with a capacity of 2,697,400 kw have been started, divided between 1,510,000 kw for public bodies and 1,187,400 kw for private utilities. These projects were concentrated in Washington, Oregon, Idaho and Montana.

Seaton told his audiences that these figures were evidence that the Republican partnership approach to power development was not stifling the production of new capacity, as Democrats have implied.

In his Press Club speech, Seaton said that the Eisenhower Administration has gotten labeled as the "party of business" by some because it practiced responsible policies in government finance, in balancing the budget and because of its attitude toward tax reduction. If it is the party of business, he asserted, it is the party of what is good business for every citizen.

The Secretary said that nowhere is this responsibility better illustrated than in his own department covering the field of natural resources. Seaton refuses to go on the defensive against Democratic resource charges. Instead he said the principle of resource development had long been bipartisan to prevent the waste and dissipation of the public domain. He said that it was not the concept of the early fashioners of natural resource policy to keep these resources in "sterile hoarding," nor to have the government get into mining, electric power or the grazing business.

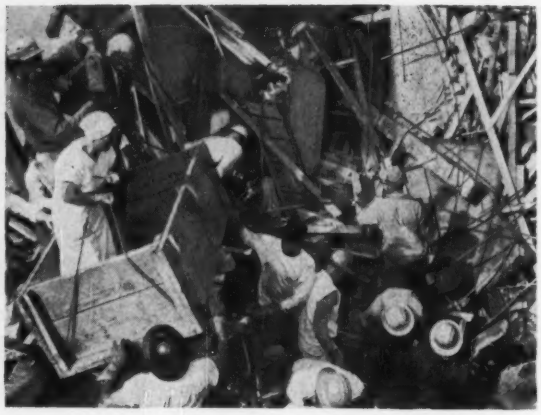
Seaton: Hard-Driving Man

In the early days, he said, nobody cried "giveaway" when the federal government, state, local, and private industry pooled their resources to get the job done faster and more efficiently. Then, it was just common sense.

This bipartisan approach continued, he asserted, until "the New Dealers developed the concept of centralizing the control in the federal government." The reason a highly centralized control of resource development is bad for the nation, Seaton said, is because it (1) destroys initiative at the local level, (2) is subject to political manipulation at the national level, (3) invites sectional rivalry for project development, and (4) dooms many areas to indefinite disappointment on needed projects.

No matter how much money the federal government takes in or how high it pushes taxes, Seaton said, there will never be enough money available to build all the projects that are needed to keep up with growth demands. The only way to finance the $50-billion worth of electrical energy installations needed over the next 10 years is through the partnership approach.

In midst of wreckage and chaos . . .



Nurse is lowered to aid workers after . . .

Consumers Power Office Building Collapses

Four separate investigations now are under way to determine why part of an office building being constructed for Consumers Power Co collapsed at Jackson, Mich., Oct. 3, killing 10 men and hospitalizing 15.

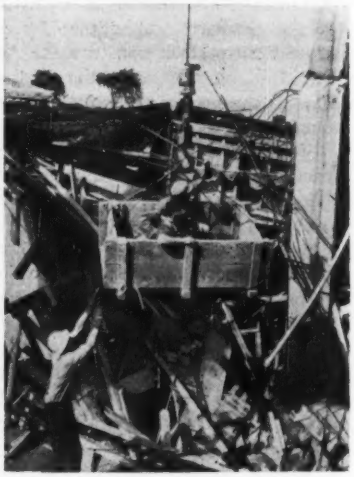
The investigations are sponsored by the State of Michigan, Herlihy-Mid Continent Construction Co, Chicago, the Michigan State Police, and Consumers Power Co.

Concrete pouring on the fourth floor of the $2.8-million, reinforced-concrete building halted abruptly when the floor gave way. Without warning, it fell on the floor below, triggering a cascade of chaos which crashed into the basement.

The ultimate fate of the building still is unknown. No damage estimate had been issued as EW went to press.

The drama of the collapse perhaps was heightened by the fact that the building eventually was to be linked by a tunnel to an underground dispatching station designed to withstand atomic bombing (EW, July 25, 1955, p 80). The latter is now under construction nearby and may be operating in 18 months.

Early news reports indicated that the office building was designed to resist atom bombs, but a company spokesman pointed out that only the underground dispatching center has that distinction. The office building was designed to be an ordinary "supplementary" office building to the big downtown office, and was to house the utility's transmission and distribution departments, and some engineering groups.



Workman is lifted to safety

"Unnecessary Accident" Takes Life of Substation Crewman

A Pacific Power & Light Co employee lost his life in what utility investigators have labeled an "unnecessary accident" at the company's large Albina substation in North Portland, Ore., industrial district.

A short caused by contact of the substation crewman, Floyd F. Ensworth, 52, ignited oil vapor in the substation atmosphere September 26. The resulting explosion and flames are believed to have contributed to the crewman's death.

Service was disrupted over a large metropolitan area for maximum of 52 minutes and caused frequencies to dip, halting some elevator service in downtown Portland buildings—including PP&L's headquarters.

Investigation indicated that Ensworth, member of crew that had been working on a bus structure in an 11,000-volt section, had reentered the section with a wrench and attempted to make some adjustments after the crew had released a clearance tag which had kept the section cold.

Circumstances mystified safety personnel headed by Safety Director Fons Hughes. Reconstructing the accident later, a company official said Ensworth had applied a wrench to a conduit saddle and, from burns on his body, appeared to have contacted an open switch blade with an elbow. He was conscious when removed from the burning area, but died later.

Damage was negligible to substation. The outage affected some industries of North Portland and residences. Company steam generating plant in Portland was speeded up to handle extra load while engineers restored service. Most interruptions lasted only few minutes.

Lunn's Bedsprings

Otto Lunn, a designer for the Walla Walla (Wash.) District office of the U.S. Army Corps of Engineers, has created a novel way of protecting the north bank of the Snake River from erosion at Ice Harbor damsite. The first step cofferdam will force the entire flow of the Snake against this shore, and erosion is expected to be particularly bad during the spring runoff.

To prevent erosion, Lunn designed a steel mesh bound rock mattress for the north bank. Most of the blanket will be tied to bedrock. It will be slush-grouted for the lower 15 ft along the toe of the slope to prevent undermining by the current. A bottom layer of 6x6-in. steel mesh is covered by a 2-ft layer of dumped rock. This is covered by two layers of steel mesh anchored to the bottom layer by ⅜-in. diam tie rods on 4-ft centers. This rig is known locally as "Lunn's bedsprings," in tribute to the designer.

English Price Rings

Here's a new twist in the foreign equipment picture: Britain's Lord Citrine, who heads the state-owned electricity industry, said he might call for U.S. bids on three $140,000 transformers. His objective is to break down "price rings" in England's manufacturing industry. He is willing to draw upon Britain's scarce store of dollars to achieve his goal.

Case of the Forgotton Bid

Because a city hall janitor at Tacoma, Wash., forgot to deliver a letter, the Tacoma Public Utility Board had to rescind an earlier contract award and place the job with another firm.

When the board opened bids Sept. 12 for substation steel structures and electrical equipment, Bethlehem Pacific Coast Steel Co had the lowest of three bids. The next day (Thursday) the board was notified that a lower bid had been submitted legally. A bid from Screw Machine Products Co had been handed to a janitor the previous Saturday. The janitor stuffed it into his pocket and forgot to deliver it until after the bids were opened Wednesday. According to Washington State law, a bid must be considered if mailed sufficiently early to arrive in time under normal delivery.

Power Is More Important

Connecticut's Public Utilities Commission has backed a decision of the Norwalk Zoning Commission which enables Connecticut Light & Power Co to build a steam plant on Manresa Island, opposite a high-priced shoreline. The PUC rejected property owners' protests that construction of the $20-million plant would seriously affect public health, safety, and welfare, and seriously depreciate property. The PUC said the need for power negated those arguments. But the property owners say they will file an appeal.

What Earl Chudoff Heard

These were among the highlights at Rep Earl Chudoff's (D-Pa.) hearing in California to learn why Roseville (pop. 10,000) can't get Central Valley Project power:

Elmer F. Bennet, assistant to Secretary of the Interior Fred Seaton, said that the department must recognize the need for more power by present preference customers. Some, he pointed out, have projected their loads to 606,942 kw by 1960, but CVP's dependable capacity is only 450,000 kw. "We believe common sense dictates that once we begin service to a preference customer, that customer's demand has priority over new requests for federal power. If we take all the customers we can find, the net result will be that our system cannot meet their increasing loads. . . ."

Clyde H. Spencer, bureau Region II director, said he has recommended that Roseville be given a CVP power contract provided that the present 25 preference customers arrange with Pacific Gas & Electric Co for additional power when they need more than Reclamation allows.

Chudoff said his staff will follow through on a request by Rep Clair Engle (D-Calif.) to investigate possible "collaboration" between top federal government officials and the PG&E to stop Roseville from buying government power.

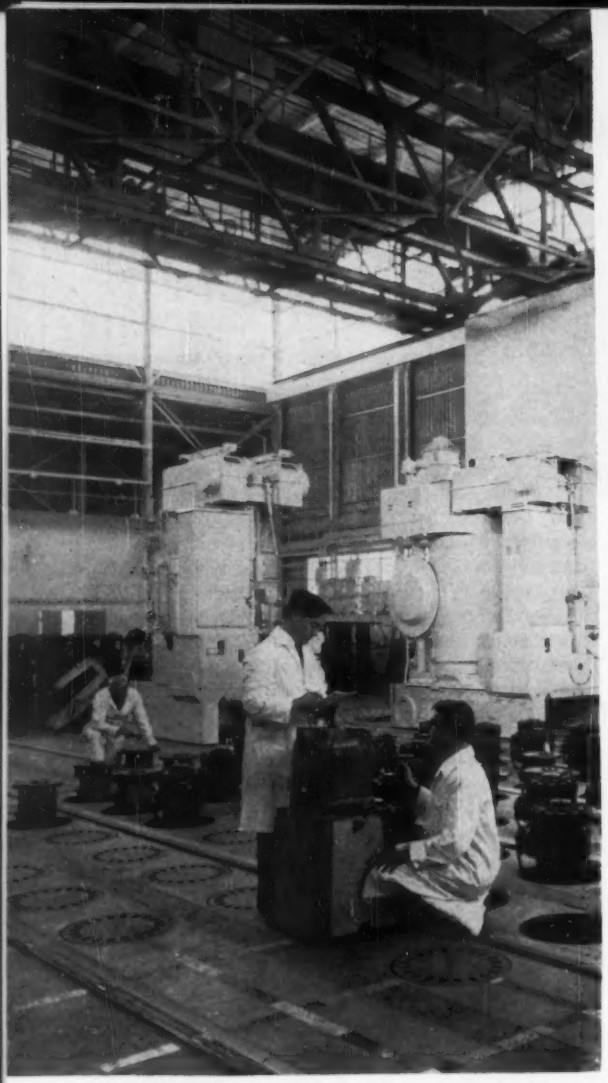
TVA Looks to 1959

Brig Gen Herbert T. Vogel, chairman of the Tennessee Valley Authority, has said that the agency cannot continue to meet its power demands indefinitely through expansion based on use of its own revenues. He said TVA hopes that Congress will approve a "revenue bond plan as a long-range solution" to the Authority's power system expansion. Vogel said TVA will be able to meet its power demands into 1959, but "our present problem is to meet the need beyond 1959."

Off-Peak Load Builders

Good applications of electric heat may be found in schools, churches, and motels. Reason: They build off-peak load. William Thompson, Edwin L. Wiegand Co, told the Interstate Power Club in New York that several Indiana schools use electric heat primarily between 4 and 8 AM while warming up for the school day. Churches and motels may consume less power, but their demands are off-peak too, he said.

Calder Hall—Britain's Hope for New Era



CONTROL ROD ACTUATORS atop one Calder Hall breeder reactor are examined by scientists for proper action

TURBO-ALTERNATORS are each rated at 23,000 kw. Ultimate capacity of 92,000 kw is expected next spring

In a small village on the northwest coast of England, the curtain will go up Wednesday to unveil the age of nuclear power.

On that date, with all the pomp and ceremony that Britain reserves for historic occasions, the Queen will throw a switch to send electricity flowing into the national grid from the world's first nuclear power station.

Calder Hall is the first step in a 20-year atomic power program that Britain hopes will provide enough electricity to save 20 million tons of coal—the amount by which her estimated coal production will fall short of estimated demand during the next 15 to 20 years.

This means nuclear power could be providing about 20%, or higher, of the United Kingdom's annual electricity output by 1975.

Calder Hall is only a prototype, and an admittedly inefficient one. Its primary purpose is to produce plutonium. Generation of electricity is a by-product. But it is the first nuclear station in the world to produce electricity for national use.

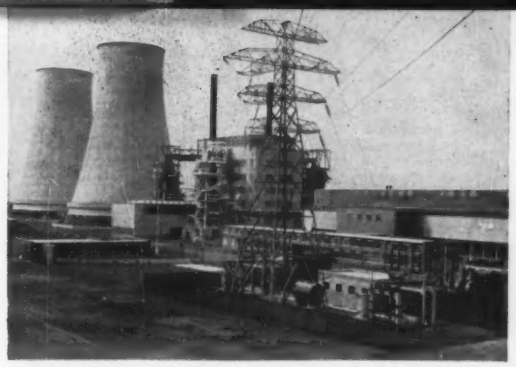
Natural uranium is the fuel in the two graphite-moderated reactors. For some weeks one of the reactors has been critical. The second is approaching the critical stage. Twenty tons of carbon dioxide circulates under a pressure of 100 psi from the hot core to the four heat exchangers which surround each reactor. In these exchangers, water drawn from the Calder River is converted into steam.

From that point on, Calder Hall is completely conventional. Each reactor feeds two standard 23,000-kw turbo alternators—a station total of 92,000 kw.

Because the primary role of Calder Hall is that of producing plutonium for the atomic energy program, the heat of the pile and the steam-generating conditions are well below the optimum for power production. The estimated $56-million cost has been borne entirely by the government through the Atomic Energy Authority. The cost per unit of Calder Hall's electrical output can have no real economic significance.

But the 12 nuclear power stations which the Central Electricity Authority is planning in its $980-million program over the next 10 years will be designed for maximum power output, and will capitalize upon experience gained with Calder Hall. Production of plutonium in these cases will take a back seat to power production. Higher temperatures in the pile and coolant will yield more heat from the same amount of fuel.

Bids for the first two CEA stations indicate the output will be three or four times that of Calder Hall. That will put them in the 200 to 300-Mw class, although basically they are to be similar in size and cost. Any evaluation of the cost per unit of nuclear elec-



QUEEN ELIZABETH will perform formal dedication ceremonies at the station's location on Wednesday, Oct. 17

tricity even from these stations, however, must come back to the market value of the plutonium by-product. AEA estimates its value between $14 and $28 a gram.

On this basis, with conservative costing allowed, the AEA estimates generating costs for the first of CEA's graphite moderated sets at between seven and five mills per kwhr. Even with home-produced coal at $11.20 a ton, the cheapest in Europe, the best of Britain's coal-fired stations cannot do better than seven mills. This does not take into account the fact that some of Britain's coal has to be imported from the U. S. at $28 a ton. The British admit that there is little hope of graphite moderated gas-cooled stations ever getting down to around three mills per kwhr obtained in U. S. hydro-electric stations.

Capital costs of nuclear power stations of the CEA type will be 2½ times as high as those of conventional stations. A fairly firm appraisal of the capital costs gives the following breakdown for a 150-Mw station: Reactor, $22 million; steam plant, $25.2 million; civil engineering, $6.7 million. Total: $350 a kw. Fuel charge adds $14 million, running up capital cost per kw to $480, as opposed to $180 for a comparable steam station. The difference would be made up in the economy of operating costs which would make unit costs comparable over a 15 to 20-year period.

ATOMIC PILE is regulated in one of two reactor control rooms. The first pile was started about four months ago

NEWS IN BRIEF

ATOMIC

Commonwealth Edison Co has received Illinois Commerce Commission approval to construct its proposed $45-million, 180,000-kw Dresden nuclear power station near Joliet, Ill . . . **Land clearing operations** and engineering and design work are under way at Rowe (Mass.) in preparation for 1958 construction start of Yankee Atomic Electric's 134,000-kw, $35-million plant.

With current negotiations underway between American & Foreign Power Co and Brazil's Atomic Energy Commission for an atomic plant in that country, Joaquim Costa Riberio, commission head, predicts Brazil will be operating an atomic power plant to supply industrial and civilian consumers in about three years.

At ceremonies marking construction start of **Canada's first atomic energy plant,** known as Nuclear Power Demonstration, Trade Minister C. D. Howe expressed confidence that Canada will reach its goal of producing electricity from atomic power at six mills a kwhr—the present cost of electricity production in coal burning plants.

Jersey Central Power & Light Co has installed an **atomic energy library** for use by its engineering personnel . . . AEC Commissioner Willard F. Libby says that, in view of the shortage of scientists and engineers, **atomic power has come perhaps 15 years too early** for the U. S. Although the U. S. should develop atomic power as quickly as possible, he said, large appropriations and a crash program alone won't "force the secrets out of nature" to make enterprises work.

HYDRO

Corps of Engineers plans to open bids Nov. 28 at Walla Walla, Wash., for south shore construction **on Ice Harbor Dam** on the Snake River . . . National Processing Co, Kans., has filed preliminary permit with FPC for construction of a **hydroelectric plant on Fremont Creek** near Pinedale, Wyo. Power from the plant would be fed to Lincoln Service Co which provides power to Upper Green River basin and Kemmerer-Frontier area.

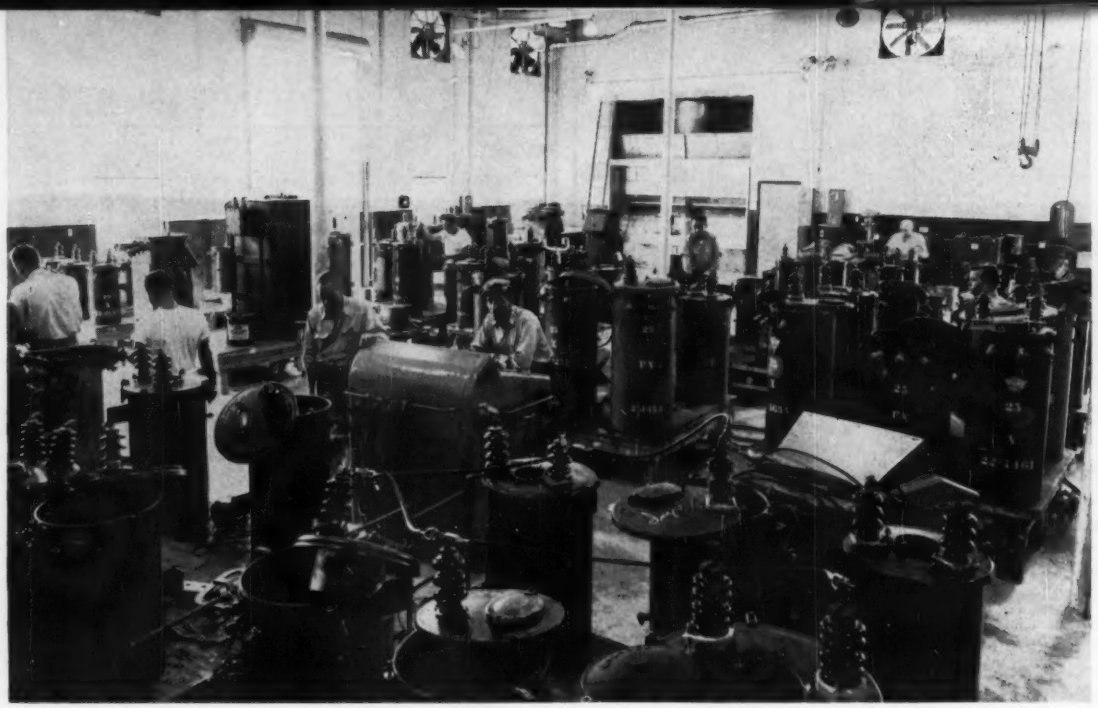
Portland General Electric Co has received state of Oregon's approval for its proposed 53,000-kw North Fork project and for the 15,000-kw addition to its Faraday plant, both on the Clackamas River. FPC has also approved the start of construction.

B. C. Electric's $8,700,000 Seton plant near Lillooet on the Fraser River, has gone on the line, adding 58,500 hp to the Lower Mainland's electrical supply. The company now plans a $43-million project at Bridge River, with installation of the last of four 60,000-kw generators slated for 1961.

STEAM

Alabama Power Co announces plans to double the capacity of its recently dedicated 250,000-kw, $35-million Barry steam plant near Mobile. Completion of the third unit, with over 225,000-kw capacity, is set for June, 1959.

(*More News In Brief on page* 270)



INTERIOR VIEW of new Florida Power & Light Co transformer repair shop makes apparent its efficient layout. In the foreground may be seen two portable test boards. The repairmen are doing routine maintenance on various unit sizes

Shop Doubles Transformers Repaired

DISTRIBUTION
Maintenance

Florida P&L designs new facilities for mass production and future expansion. Industry experts call them "most efficient"

LOWIS CARLTON, Florida Power & Light Co, Miami, Fla.

After five-years' planning and 11-months' construction Florida Power & Light Co's new transformer repair shop is now in service. One executive of Ebasco Services, Inc, called it, "The most modern, efficient, and effective plant of its kind I've seen."

Shop Supervisor H. S. Brown predicts he can triple the former output with a few additional personnel. Already, increased efficiency of the shop has nearly doubled work output.

12,000 Transformers Handled Annually

At present, it is a job shop operation. Units move through the shop in less than 48 hours. But flexible planning permits a quick shift to production-line operation if desired.

The new facilities were required to meet the growing demands of the expanding southern Florida area. Transformers cleaned, tested, and repaired annually now number about 12,000 compared to 6,500 five years ago, and the work load is climbing by about 2,000 transformers a year.

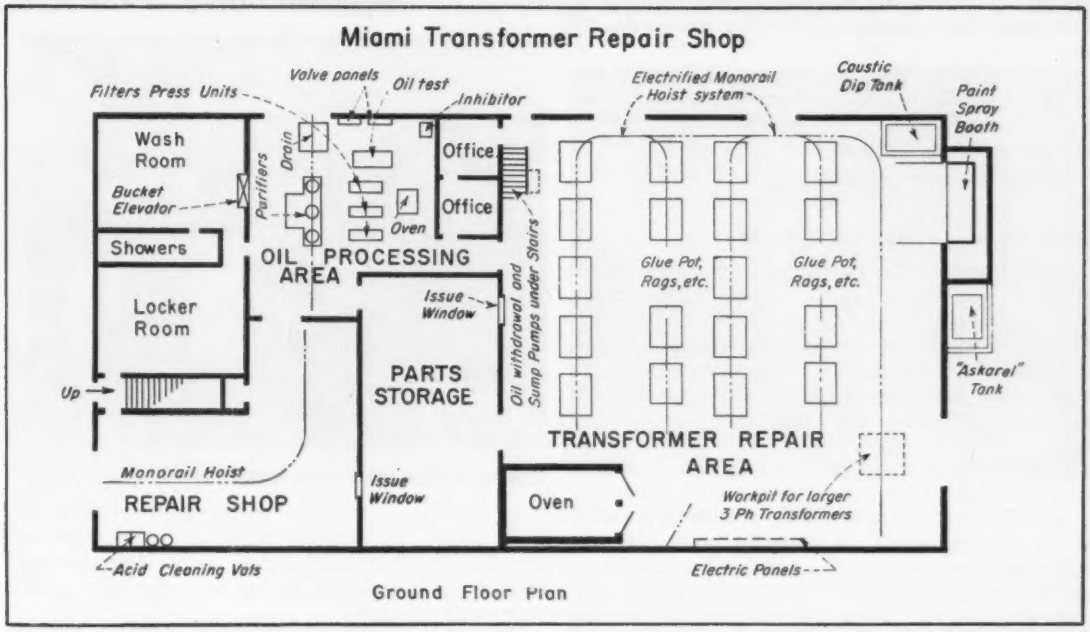
Seeking successful shop layouts of a similar nature, FPL engineers sent inquiries to many utilities. They found that most companies were puzzling over the same situation. So the company proceeded with it's own design, using stock equipment modified in the factory or FPL shops to meet the need and allow for expansion during the next 10 years.

Site for the new facilities was the old shop. It consisted of a 2,400-sq ft metal-covered structure and a 1,500-sq ft newer concrete-block and stucco building. These two buildings were dimly lighted and so over cramped that a minor emergency created large scale confusion. Some high-voltage tests were made by connecting transformers to exposed overhead wires at specific work benches. During tests the area had to be roped off, impeding the handling of transformers in and out of the shop and causing delays.

Area of New Building Is 11,700 Sq Ft

To overcome these and other problems, the obsolete metal building was replaced with a 3,900-sq ft block building. This was combined with the existing concrete-block structure into a modern building having 11,700 sq ft for shop and office, including 800 sq ft for parts storage.

Many improvements were incorporated in the new well-lighted building (See accompanying box). Major advancements include the oil reclamation and handling facilities and test equipment for street-light transformers, dis-



FLOOR PLAN OF MAIN SHOP shows exact location of all equipment. Check with the photograph on the opposite page to get a better idea of space between work stations. Offices on second floor are both soundproofed and air conditioned

tribution transformers, and rubber safety equipment.

Installed for the insulating oil facilities were three new Fuller's earth purifiers, a new filter press to supplement two existing ones, and two new oil storage tanks for a total of six, or 23,600 gal. Without unnecessary duplication piping interconnects equipment and also runs to alternate work benches. Oil transferring is accomplished at two valve panels where only the valve handwheels are visible, each clearly marked to indicate its function.

Processing of oil was isolated from the work area with the operation entirely automatic, except manual valve switching and recharging purifiers. All operations are simple, apparatus is extremely flexible for variations in processing needs, and maintenance can be performed without affecting normal operations.

6 Tanks Handle Transformer Oil

Under the new plan, oil-cycle operation starts with a 30-gpm, 12-ft suction, 15-ft discharge head pump operated by push button at work benches. This pump withdraws oil from transformers and delivers it to storage tank No. 1. From this tank oil is pumped to the purifiers and two of the filter presses and then back to tanks No. 2 through 5, working in succession or skipping, as desired.

Tank No. 6 is reserved for completely purified oil. Feeding into the supply to this tank is an injector pump delivering inhibitor at a rate equal to 3% of oil flow.

To avoid overflowing a tank, lights in the processing room warn when oil has reached a high level, and a horn sounds until shut off manually or oil level has dropped. Purifiers, each rated at 5 gpm, can be operated in series or parallel, as can the two filter presses, each rated at 30 gpm

The third filter press is devoted exclusively to removal of oil from tank No. 6, thus insuring a high dielectric strength. Controls for this press are located at the work benches where the oil is pumped for flushing and filling transformer tanks. During maintenance locked valves may be operated to permit either of the other presses to service this purpose.

Flushing oil is returned by gravity to the sump used for draining bags of Fuller's earth. From here dirty oil is delivered to tank No. 1 at 20 gpm by a float-operated pump.

To conserve space, Fuller's earth is stored in a metal hopper occupying the space above the purifiers. A bucket conveyor, concealed in the wall, carries earth from a feed trough at ground-floor level to the hopper. In the bottom of the hopper is a lever-operated gate in a spout, with a flexible hose attached, through which earth feeds during recharging of purifier bags. Capacity of the hopper conforms to bulk quantity rail shipments, to realize greatest economy in purchasing.

Special Board Tests Street Light Unit

Next, a new test board for street-light transformers, flexible enough to use for small and large units was designed, taking into consideration operating results from a similar older unit. The new board, including the circuit breaker, measures 6 ft high by 2½ ft square and is a fixed test panel with a capacity up to 40 kw.

The resistance circuit in the panel is tapped at points to facilitate the test of equipment. Test values conform to standard transformer ratings of 3, 5, 7½, 10, etc, up to 40 kw.

At given intervals in the resistance circuit, disc film cutouts are installed to eliminate high-voltage hazards to the operator in case of an open circuit. The discs puncture at about 110 v; whereas the over-all voltage on the circuit

may run up to 5 kv. The board is designed with a dead front panel; and in operation, all safety precautions are taken.

Initial cost of this board was slightly higher than that of the former one, but maintenance costs will be less because there is little replacement. Besides being safer, the new board saves 300 to 400% in time for a complete set of tests on a transformer. It requires only one third as much space.

Mobile Equipment Needed for Tests

A survey showed that mobile equipment was desirable for routine tests of transformers, such as core-loss, polarity, ratio, and hi-pot tests. As special tests would be required, variable test voltages were also needed. The unit must be compact and, above all, safe. Most tests were to be made at 8 kv or less. In addition, there was need for hi-potentials up to 35 kv for tests separate from the main board.

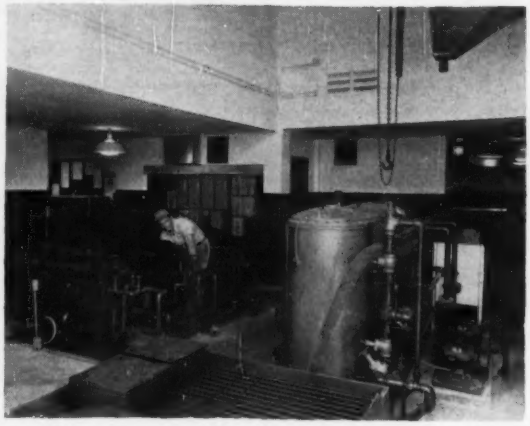
Normally, one man and one board could meet requirements. But with test boards being moved to the equipment, occasionally boards would be needed at more than one location at the same time. Trials proved that preliminary tests could be made by one board and final tests by the other, to meet any emergency.

Company Made Own Test Boards

Because such equipment was not on the market, both units were completely fabricated in the transformer shop. Building the main board required about six weeks of one man's time. The second board required about three and one half weeks. Both portable boards were based on components from two older boards and many modifications.

Tests that can be made with the main test board include core-loss tests at 120 or 240 v, polarity tests, ratio tests at 2,400 and 7,620 v, and hi-pot tests at 2,400 and 8,000 v. A variable test voltage from 0 to 8,000 v is available.

Equipment Used in the New



Oil purification apparatus . . .

All meters and operating relays are below surface to provide a dead-front panel. Before the board can be energized, operating personnel have to be "in the clear" to operate safety switches.

The "follow-up" test board is used for 2,400 and 7,620-v ratio tests and hi-pot tests from 1 to 35 kv. This unit also has safety switches and dead-front construction.

Shop personnel also built test sets for calibrating photoelectric switches and one unit for testing series-circuit protective units.

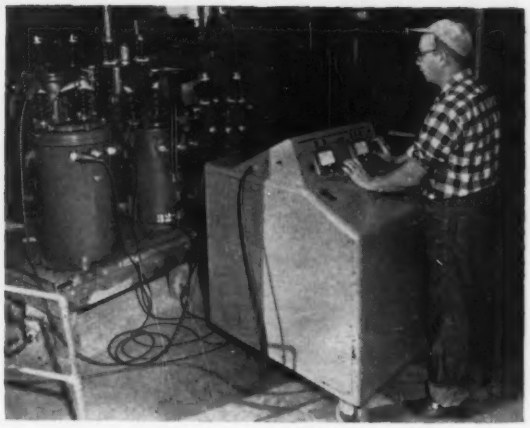
Also assembled in company shops was equipment for testing rubber-goods for the entire system. Although ac tests were formerly used, it was decided to use dc for part of the tests, requiring many changes. Because the laboratory was laid out for one-man operation, simplicity and

Improvements in the New Shop

- Oil reclamation and handling system is almost completely automatic including injection of inhibitor.
- Overhead hopper stores Fuller's earth and quickly feeds it into purifiers.
- New boards speed testing of different type transformers and equipment.
- Drying oven improved by increasing insulation and fitting doors better. Atop drying oven is substation serving the shop.
- Electric hoist on mono-rail system handles heavy transformers anywhere in the shop.
- Large fans ventilate work area.
- Department for rubber goods testing was enlarged and washroom space doubled.
- Parts storage located on ground floor is convenient to all work areas.
- Special area is for repair and test for subway-type and substation transformers up to 1,000 kva.
- Paint stripping tank, acid cleaning dip tanks, and paint-spray booth are conveniently located.
- Fork-lift trucks with overhead booms move transformers in and out of shop.
- Most offices are upstairs, with fluorescent lighting and air conditioning.

Transformer Repair Shop Includes . . .

Core loss and ratio tester . . .



High potential tester . . .

safety were considered to be of the greatest importance.

Also, the equipment had to be flexible enough to handle emergency quantities of rubber goods in event of tropical storms. Moreover, it must be capable of change to higher test values, if desired, at a later date. Leakage tests under load, flexibility of procedures, and ability to test with either ac or dc with minimum lost time were desirable.

The ac components permit tests up to 35 kv with provisions for reading milliamp leakage on all or on any one of 12 gloves under test. The dc layout is similar but has an output of up to 50 kv, with leakage values normally read in microamps.

Remote controlled switches enable the output of the board to be changed from ac to dc. Because ac voltage is sometimes used in oil testing, switches are provided to disconnect testing equipment for either oil or rubber goods when not in use. Dc voltage is supplied through a half-wave rectifier and necessary capacitor. Protective relays insure at least 75% of normal filament voltage is applied before plate voltage is applied.

Because voltages are all high, numerous safety switches were incorporated. Double grounding of test bus, door interlocks, and "zero return" characteristics were included. If the operator forgets and starts into an energized cage, the circuit trips and grounds out.

One Man Tests 2,000 Pair of Gloves in a Month

Interlocks are provided so the board controls must be lined up correctly before the circuit can be energized. Normal operation starts at zero voltage, and, with the correct line-up of switches, voltage is built up to desired value. Failure of equipment being tested automatically opens the circuit breaker, de-energizes the equipment, and grounds the circuit. To re-energize for test, controls must be returned to zero voltage settings.

Normal monthly output for one man's operation is now approximately 2,000 pair gloves, 1,000 pair sleeves, and a small amount of miscellaneous protective equipment.

Judging by the stepped-up volume of work turned out, by the ease and efficiency with which employees work, and by reports from utilities around the country, FP&L engineers feel this is now the nation's most outstanding transformer shop.

Rubber goods test board . . .

Street light transformer tester

SAMUEL C. MOORE hydroelectric development on the Connecticut River is shown in aerial view. Photo shows the dam, powerhouse, intake, and spillway sections of this new 15-Mile Falls development 7 miles upstream from Comerford

$43-Million, 150-Mw Moore Plant

GENERATION
Design

Generation and transmission facilities in 15-Mile Falls section stress improved design for reliability and economy

D. R. CAMPBELL, Engineer, **T. J. ROUNER,** Vice President, **H. R. STEWART,** Electrical Engineer, New England Power Service Co, Boston, Mass. *

The 150-Mw Samuel C. Moore hydroelectric development, due for completion this year near Littleton, N. H., will round out New England Electric System's utilization of the Connecticut River. The $43-million development is about the last large feasible hydroelectric project on New England's largest river which extends 420 miles from mouth to headwater lakes. No other United States river of comparable size will then match the completeness of its power developments. Of its 750-Mw installed capacity, 530 will be on the main stream.

Named for a founder of the system, Moore's first generating unit went into operation last May, and its four 37.5-Mw machines will be in service soon.

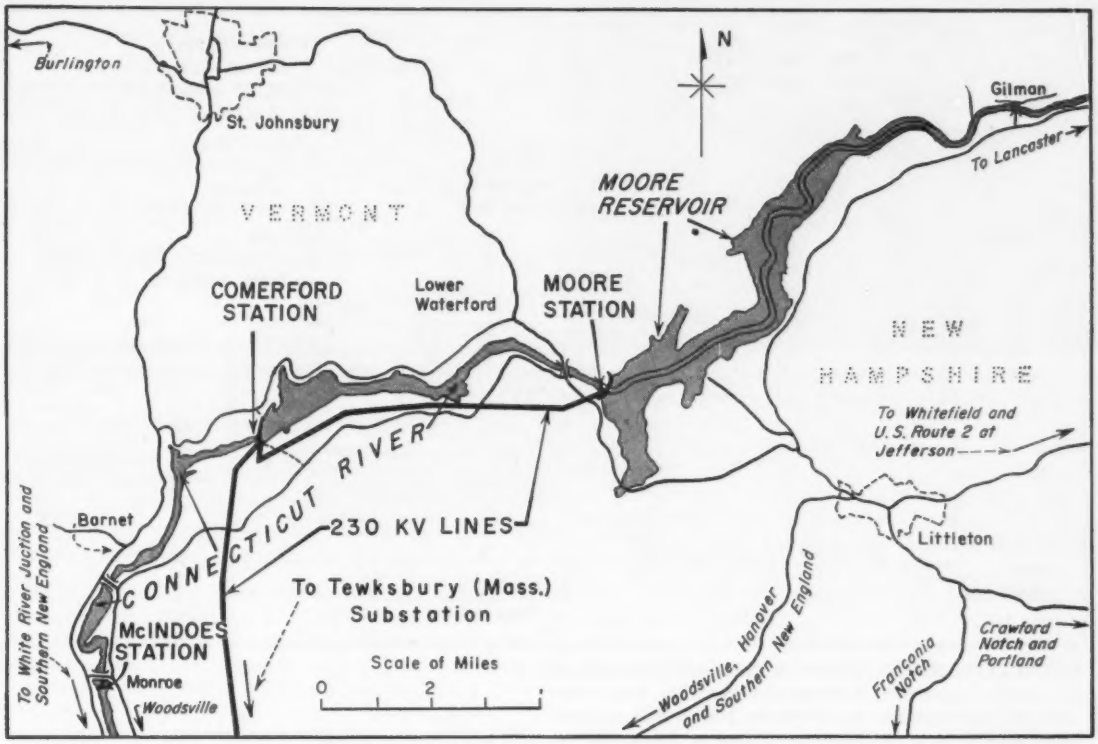
This new 15-Mile Falls development is 7 miles upstream from the 150-Mw Comerford installation, built by the utility group in 1930 to serve the extreme peak loads of its large interconnected power transmission network. Below Comerford, the system's 10-Mw McIndoes low-head (29-ft) plant partially re-regulates the peak discharges from Comerford to enable downstream developments to make reasonably effective use of the water.

*The authors wish to acknowledge the co-operation of E. O. Erickson, Engineer, New England Power Service Co.

Peak Load Generation Brief

With 159-ft gross head, Moore development calls for 12,500 cfs of water at normal capacity and full pond. This flow from a 1,600-sq mile drainage area is available continuously only under freshet conditions. During droughts Moore, like Comerford, normally will generate peak load power only a few hours daily. When Moore is shut down for lack of water, the transmission network will bring fuel-generated power into New Hampshire and Vermont to carry local loads. The combination of inland hydro and large steam plants on the tidewater, where shipping costs are lowest, has constantly proved to be New England's best and least costly power arrangement. At Moore, available storage is 5 billion cu ft, which is far short of full seasonal control of river flows. At headwaters reservoirs, 8 billion cu ft more is available.

Normal head water is at 809-ft elevation above mean sea level, normal tail water at 651 ft.



MAP of New England Electric System's power developments in the 15-Mile Falls section of Connecticut River shows locations of Moore, Comerford, and McIndoes plants and the 230-kv transmission line linking Moore and Comerford

Climaxes Connecticut's Utilization

At the upper end penstocks are controlled by 18 x 24-ft wheel gates operated by 60-ton electric hoists. Sills at elevation 725 permit operation of the plant under a 40-ft drawdown. Intake openings have full-height racks of round-edged flat bars and steel supporting members. Racks and supports were designed for a 10-ft difference in head to allow for some rack clogging.

Penstocks Designed for 13,750 Psi

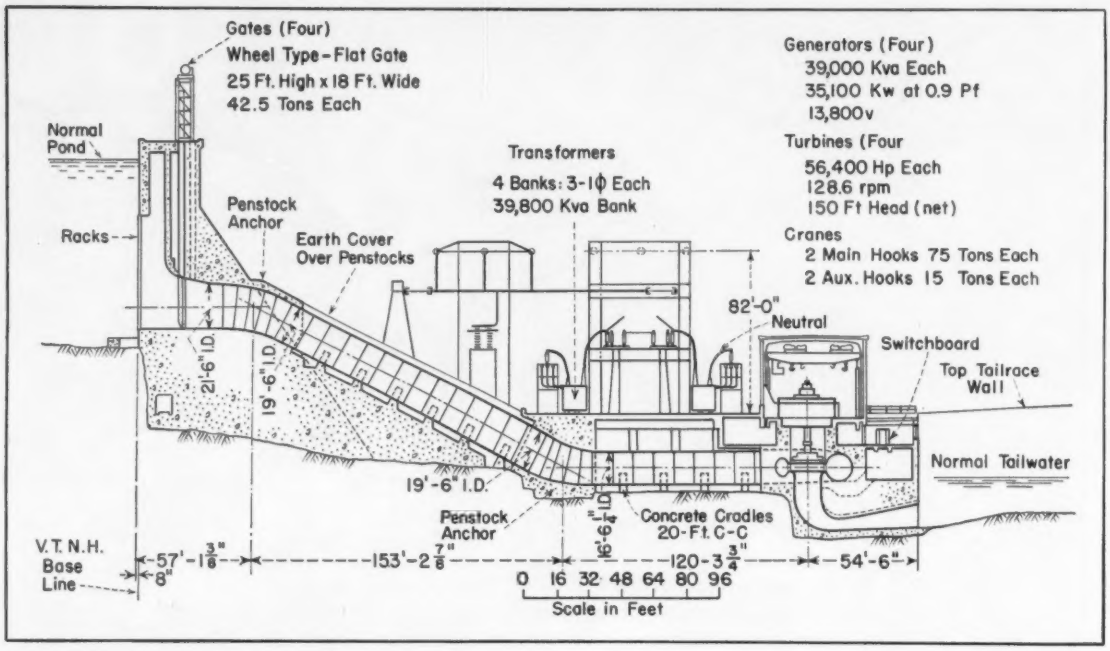
Penstocks were designed for 13,750 psi, with 85% efficiency of joints, and for static head, plus a pressure rise above pond level varying from zero at the intake to 80 ft of water at the outlet end. A corrosion allowance of ☆ in. was added. Each penstock was hydrostatically tested to 150 psi at the lower end, and after inside and outside painting was earth covered to prevent ice formation.

Studies showed that neither the outdoor, nor the semi-outdoor type of building was justifiable from either the economic or operational viewpoint. However, the power house, although fully enclosed, is of rather unique design and fundamentally the outdoor type. The control room switchboard, and other appurtenances are inclosed in the substructure below the generator floor level. The superstructure is merely a shelter for cranes and generators. Thus an expensive outdoor gantry crane, hatches, and generator envelopes were not needed, and shelter is available for men and equipment during periods of repair at a substantial cost saving over a more conventional design and at about equal cost to an outdoor design.

Turbines Directly Connected

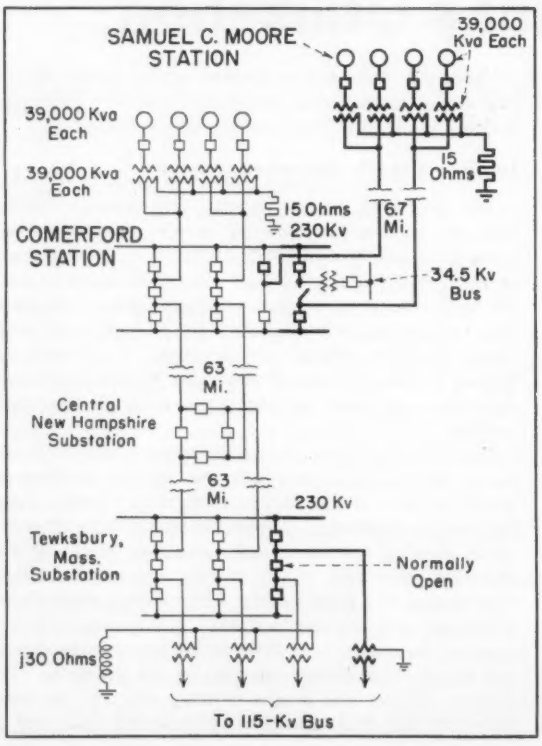
The four turbines are vertical, single-runner Francis-type wheels, directly connected to the generators. Each is rated 56,400 hp and 3,970 cfs under 150 ft net head at 128.6 rpm. This is full load rating and hence exceeds the requirements for normal operation at best efficiency. The turbines are set in plate steel riveted scroll cases connected to the welded steel penstocks. Draft tubes are formed in the concrete of the upper power house substructure, and there are plate steel liners in the upper portion.

Transmission studies in 1929, when Comerford was in the design stage, presumed that Moore development would be built in the 1930's. Comerford's design called for the first high-speed 230-kv circuit breakers (8 to 12 cycles clearing time) and took advantage of (1) neutral grounding resistance at the sending end of the 230-kv transmission to provide braking effect during single-phase-to-ground and 2-phase-to-ground faults, and (2) low transient reactance, high WR^2, quick response excitation, and double-deck damper windings in the generator. The damper winding was to give braking effect in the outer high-resistance deck during an unbalanced fault and in



MOORE DEVELOPMENT is shown in this cross-section through the intake, penstocks, and powerhouse. The last's four turbines are vertical, single-runner Francis-type wheels, rated 56,400 hp and directly connected to the generators

230-KV CONNECTIONS and switching between Moore, Comerford, and Tewksbury. Heavy lines are Moore additions



the inner low-resistance deck during oscillations consequent to the clearing of the fault. Had Moore Station been built as originally anticipated, stability requirements would have been met by building a third 230-kv circuit from Comerford to Tewksbury, sectionalized at the midpoint, as were the two initial circuits.

Breakers Are 3 Cycle

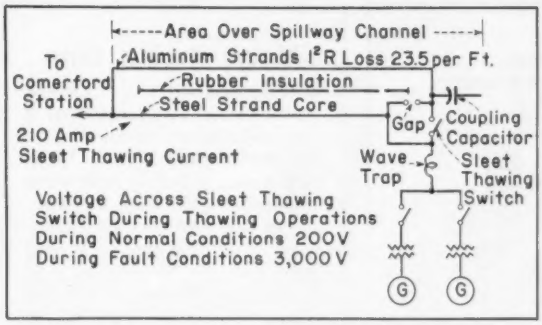
Conditions changed during the depression, and then World War II deferred construction. Engineering developments, meanwhile, reduced circuit breaker clearing time from the 8-to-12-cycle range to 3 cycles and made carrier relaying and high-speed reclosing transmission commonplaces.

Stability studies in the early 1950's showed that 3-cycle breakers and carrier relaying met the criterion for a 2-phase-to-ground fault and that the third Comerford-Tewksbury circuit was not needed. High-speed reclosing gave an additional safety margin at virtually no increased cost. Rather than the usual 20 cycles, 25 cycles round trip gave ample time for fault-arc deionization. High-speed reclosing involves the occasional risk of reclosing into a fault either before the arc has deionized or when a circuit is struck by a multiple lightning discharge. Ac network analyzer studies, however, have shown that the system is still stable when reclosure from a 2-phase-to-ground fault took place into a single-phase-to-ground fault. Hence, it is felt that the high-speed reclosing constitutes a net gain.

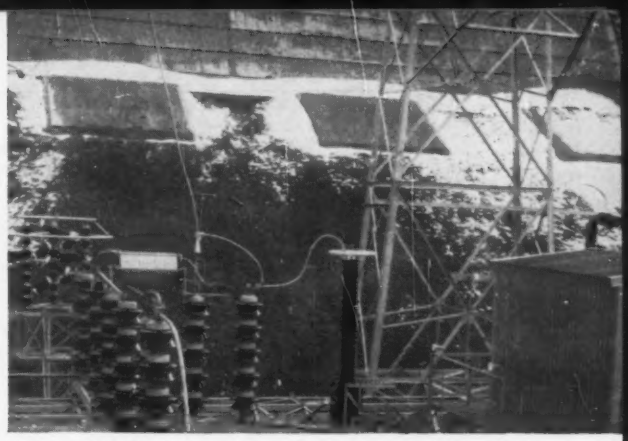
Resemble Comerford Units

Counterpoises were added to the existing 230-kv steel-tower lines.

Moore generators have transient reactance, WR^2, and quick-response excitation characteristics similar to those of the Comerford generators. These features have beneficial stability effects both during and after fault clearing.



THESE ELECTRICAL CONNECTIONS were provided for thawing sleet on transmission conductors over area of the spillway



SLEET THAW SWITCH at Moore is two-stack switch located between carrier wave trap and carrier coupling capacitor

But the high-resistance deck of the damper winding was omitted from the Moore machines. As the deck is effective only for the fault duration, which is now reduced in about a 3-to-1 ratio, its retention was unjustified.

BIL Cut to 800 Kv

Recent lightning arrester improvements permitted a reduction in insulation level of all new 230-kv equipment, such as transformers, circuit breakers, disconnect switches, and bus supports. The originally required BIL of 1,050 kv has been cut to 800 kv. This reduction has saved some $350,000 at Moore, Comerford, and Tewksbury.

At Tewksbury substation a further cost saving was made in that the added 69,000-kva transformer bank consisted of fan-cooled autotransformers rather than water-cooled, two-winding transformers, such as were used in the original installation. The fan-cooled rating raised the otherwise low impedance of the autotransformers to the level of that of the original bank so that paralleling requirements were satisfied. The necessary solid neutral grounding of the autotransformers largely bypasses the neutral grounding reactor in the neutrals of the other Tewksbury transformers. This has a negligible effect in diverting ground current from the neutral grounding resistors at the sending end during ground faults and does not affect transient stability adversely to any calculable degree.

Conductor Diameter Increased

The 230-kv circuits between Comerford and Tewksbury were built as two steel-tower lines with 795-MCM ACSR conductor, 1.09-in. OD, and 23-ft 6-in. flat spacing. System experience since 1937 with "polarm" construction at 69 and 115 kv showed that this could be adapted to 230 kv for the new 6.7-mile lines from Moore to Comerford. The design resulted in a 16-ft 8-in. instead of a 23-ft 6-in. conductor spacing. But conductor diameter had to be increased to yield the same surface voltage gradient and thus avoid increased corona and radio interference.

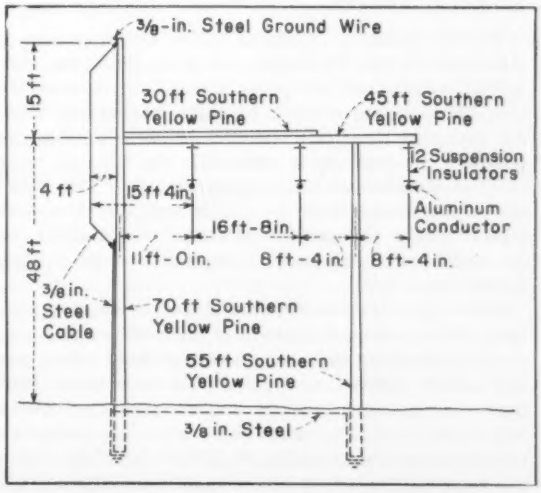
Conductivity requirements, however, were low, each of the two circuits carrying only 200 amp maximum continuously. This requirement could be satisfied by use of an expanded aluminum conductor of 1.12-in. OD and only 554-MCM of cross section of aluminum strands over an aluminum core in the shape of BX armor.

Transmission conductors are suspended from twelve 10-in. disc-type insulators in standard preformed armor suspension clamps. A ⅜-in. aerial galvanized shielding wire on the higher pole of the structure, 15 ft above the end of the crossarm, provides lightning protection. This shielding wire is grounded by a structure down lead, bracketed out from the pole. Thus there is 23 to 25 ft of wood insulation in series with the porcelain insulators, a combination equivalent to at least 30 standard discs at 3 micro-sec on a 1.5 x 40 micro-sec wave.

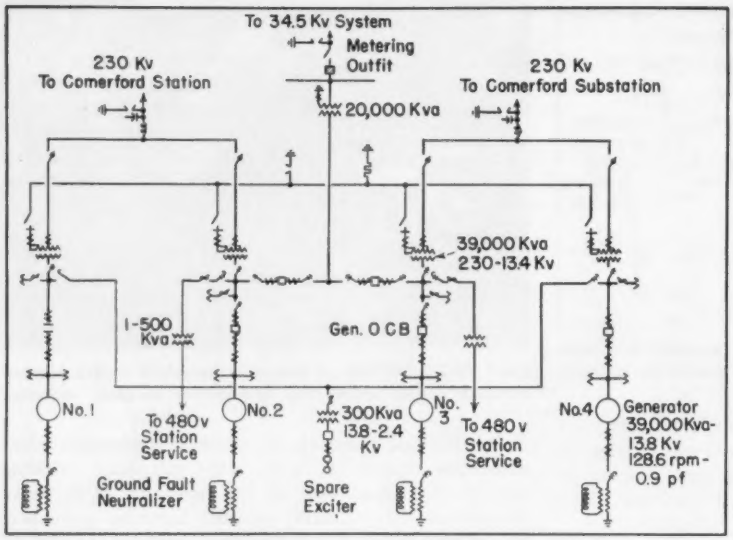
Previous experience with similar lines at 115 kv indicates that the rate of lightning tripouts will be less than one per 100 circuit miles per year. Consequently, counterpoises are not considered justified on the "polarm" lines.

Provides for Thawing

The first few hundred feet of the 230-kv line takeoff at Moore cross the spillway channel. As water turbulence during discharge on cold nights is a potential cause of excessive ice formation on overhead conductors and shielding wires, a special transmission conductor is used to prevent interruption. It consists of a 19-strand steel core, 124 mils of rubber insulation over the core, and a single layer of 24 strands of aluminum, having a conductivity of 354 MCM. Overall diameter is about 1.121 in. With-



CONFIGURATION and materials of the 230-kv "polarm" structure for the line between Moore and Comerford plants



SCHEMATIC of main connections at Moore station show unit-wise arrangement of generators with step-up transformers. High-voltage neutrals of the main banks are grounded through 15-ohm resistors. Switching is automatic

Moore Project Data

Capacity (nominal).....150 Mw
Usable Storage.....114,000 acre ft (40 ft max. drawdown)
Net Average Head.....149 ft
Pond Area.....Approx 3,500 acres
Powerhouse—265 ft long, 52 ft wide, with 25 ft additional width below generator floor and 20 ft wide extension upstream
Turbines (4)—128 rpm, vertical, single-runner, Francis-type, 56,400 hp each under 150 ft net head
Generators (4)—umbrella-type vertical, air cooled, rated 39 Mva, 0.9 pf, 13.8 kv, 60 cps
Generator Breakers, 15 kv, 2,000 amp, 1,000 Mva interrupting capacity
Transformers, 4 banks, 3 single-phase, water-cooled units, each 13 Mva, 13,400/230,000 v with one spare.

out service interruption, a disconnect switching scheme forces the load current to flow only through the steel strand core during sleet-thawing operations.

Sleet Thawing Provided

A sleet-thawing current of 210 amp produces an I^2R loss of 23.5 w per ft of conductor. During sleet thawing a potential of 200 v is present between the steel core and the aluminum strands at the station end and a maximum of 3,000 v when a fault occurs. Shielding wires over transmission conductors in the spillway are set up for sleet thawing from a station service source. Such wires, consisting of ⅜-in. galvanized Siemens-Martin steel strand, require 165 amp at 190 v to give an I^2R loss of 27 w per foot of shielding wire on the longest circuit. Sleet thawing for shielding wires of both circuits takes 60 kva total.

Protection Installed

Each generator is connected unit-wise with its step-up transformer bank. Two banks are in parallel at the high-voltage side for connection to a single transmission circuit. High-voltage neutrals of main transformer banks are grounded through a 15-ohm resistor. Switching of generator oil breakers is automatic, the breakers being rated at 1-million kva interrupting capacity. The 230-kv station connections have no circuit breakers. Motor-operated 230-kv disconnects, electrically interlocked for dead-blade switching, clear the high side of main transformer units.

Each generator has differential and overload protection. Main step-up transformers have differential protection. Distance and over-current ground relays protect 230-kv circuits. Loss of a main transformer bank trips two generator breakers and corresponding 230-kv line breakers at Comerford by means of power-line, carrier-current transfer trip. A 230-kv line failure trips two generator breakers at Moore and associated line breakers at Comerford.

Generator units have over-voltage trips to operate at 16 kv. Each generator has overspeed protection for shutdown at 215 rpm, 5% above full-load rejection overspeed. Grounding of each generator neutral is by ground-fault neutralizer which sets up a tuned circuit to give a minimum ground-fault current. This limits damage at the fault point, limits transient voltages, and provides a sensitive means of detecting insulation deterioration.

Fault Currents Limited

As this type of grounding system limits fault currents to less than 1 amp, immediate shutdown of the unit is not necessary when a ground fault occurs. Thus dispatchers have ample time for replacing generator capacity. When a low-resistance ground fault does not clear itself, a timer automatically trips the unit after a predetermined setting of about 1 hr.

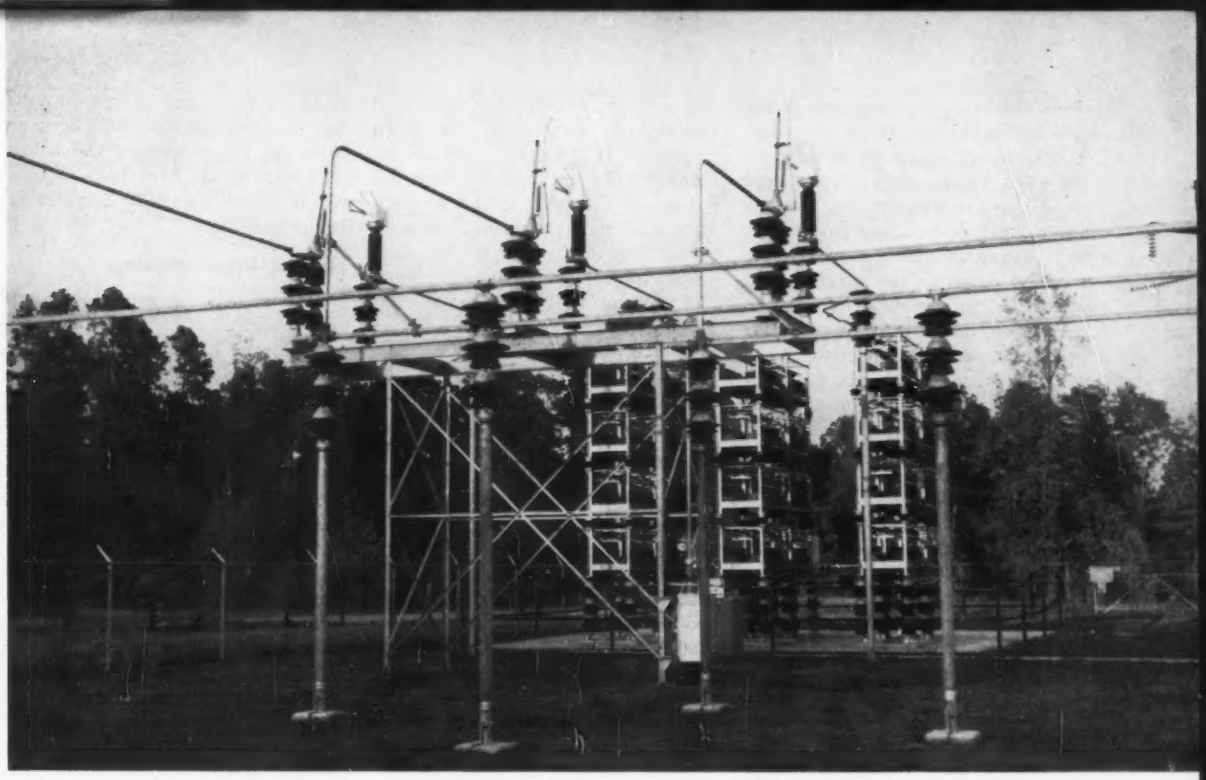
Inside the plant main generator connections are three 3 x ¼-in. copper bars on 15-kv station post-type insulators. Extension to the outdoor low-voltage switching structure is by two 2,500-MCM concentric insulated cables. Each cable is rated at 970 amp continuously at 75C copper temperature, 20C ambient. The cables have short-time ratings at 500 and 100 hr to allow periods of generation at occasional higher outputs.

480-V Feeds Auxiliaries, Lighting

Station service auxiliaries and lighting are fed from a 480-v system supplied from two 500-kva transformers connected to two of the main generators. Supplementary power is available from the 230-kv and the local 34.5-kv installations. Connected station service load is about 600 kva at the powerhouse and 250 kva at the dam, normal total load being about 400 kwhr over an hour's period. One factory-built station service control center is in the powerhouse and another at the dam.

Station service control centers are designed to withstand a maximum short-circuit current of 15,000 rms amp. By automatic closing of the bus sectionalizing

(*Continued on page* 280)



9,600-Kvar Shunt Capacitor at Louisiana P& L's Winnfield Sub has innovations to . . .

Save on Switching and Protection

SUBSTATIONS
Design

Interrupter switch, controlled by time clock, supplants circuit breaker. Protective relay checks voltage balance

H. L. DELONEY, Asst Chief Engineer, Louisiana Power & Light Co, New Orleans, La.

W. H. CUTTINO, Switchgear Distribution Apparatus Engineering, Westinghouse Electric Corp, East Pittsburgh, Pa.

Motor-operated sulfur-hexafluoride switches and a novel relay scheme saved approximately $24,000 for a 9,600-kvar, 110-kv switched capacitor installation at Louisiana P&L Co's Winnfield Substation.

This substation, located approximately 90 line miles from the nearest generating station, is a "low spot" on the transmission grid. Distribution capacitors had already been applied to their practical limits on lines and buses in the area. Additional voltage correction was needed particularly when either of the transmission sources was out of service. The 9,600-kvar bank boosts voltage approximately 3.5% under normal conditions and 7% with either of the two source lines open.

The Winnfield capacitor installation is a 110-kv, 3-phase, ungrounded-Y bank of eight 7,960-v series groups per phase. Each series group has sixteen 25-kvar 7,960-v capacitors in parallel. A 115-kv, 3-pole, gang-operated SF_6 load-interrupting switch combines the functions of circuit interrupter and disconnecting switch.

SF_6 Interrupter Aids Switching

This switch resembles a conventional 115-kv disconnect switch, but its stationary contacts carry interrupters coordinated to trip after the main switch blades have opened. The interrupter contacts then part, drawing the arc through an orifice in the gas-filled porcelain housing. The moving contact carries a piston which forces some of the SF_6 through the orifice where the arc is drawn. High dielectric strength of the gas, together with the deionizing effect of flow through the orifice, combine to extinguish the arc, thus interrupting the current and disconnecting the capacitor from the circuit.

In a closing operation, the circuit is first established through the interrupter prior to closing on the main switch contacts. The unit can switch a single 115-kv, three-phase capacitor up to 10,000 kvar.

The SF_6 switch cost approximately $0.50 per kvar, whereas a conventional 115-kv OCB for a bank of this size would have cost approximately $3 per kvar. Had a larger bank of capacitors been installed to spread the cost of a conventional OCB, the voltage rise would have been too much to absorb in one step of switching.

Switching with the interrupter makes switched capacitor operation practical and economical for high-voltage capacitor banks up to 10,000 kvar for 115 kv in areas remote from generating stations where not more than 500 operations are expected be-

tween switch maintenance periods and switched banks are widely separated. It is necessary, therefore, to limit installations to one bank of this type on a given substation bus because heavy capacitor-bank interchange currents during switching would impose excessive duties on the switches. But the desired voltage correction can be obtained by properly distributing the switched capacitor banks between various substations within the low-voltage area. This method also attains the minimum system transmission losses.

Clock Controls Switching

The capacitor bank at Winnfield is arranged for time-clock control to switch it "in" at 7 AM and "out" at 10:30 PM on weekdays. Future plans call for switching this bank and others to be installed within the area by supervisory control. Voltage switching is possible, of course, but the arrangement used is cheaper because a potential device to measure 115-kv bus voltage is not available in this station. The performance of time-clock control is considered satisfactory.

Short-circuit protection for the capacitor bank is provided by standard high-voltage power fuses. Indicating individual fuses are customary on large capacitor banks to detect and disconnect a faulted capacitor unit. But a relay scheme was considered desirable to supplement the visual inspection of individual fuses as an indication of objectionable voltage unbalance in the capacitor bank. Such unbalance could be caused by individual fuse operations or by some foreign object getting into the bank and shorting out one or more series groups. This relaying is in addition to overcurrent protection for removal of major equipment faults on the capacitor bus.

Unbalanced phase voltage was selected as the most economical basis for relaying a single-Y capacitor bank of this size and voltage rating. It requires three capacitor potential devices and an insulating transformer as shown in Fig 1. This method assures good reliability and ease of adjustment and is sensitive enough to detect small changes in capacitor phase-to-neutral voltages. Fig 2 shows the voltage increase on the remaining capacitors in one group and the voltage detected by the unbalance relay as capacitors are disconnected from the group.

This method was selected in preference to several other relaying schemes including those shown in Figs 3, 4, and 5. Harmonic currents can be expected on Y-connected grounded-neutral capacitor banks which seriously handicap the use of neutral ground current for relaying. It would have been desirable in this case to relay on very small 60-cps currents. But harmonic current could be many times the 60-cps current and a low-pass filter would have been required which would materially decrease relaying sensitivity.

Neutral Relay Unsuited

Measurement of neutral-to-ground voltage instead of current reduces difficulty from harmonic currents but, like the neutral-to-ground current scheme, is subject to change in signal because of variations in phase voltages. There is usually some unbalance in system capacitance which might exceed the unbalance at which it is desired to relay. High unbalance could also occur between the capacitor neutral and ground during a system fault. And sequential conduction when closing the capacitor switch could cause large transients between capacitor neutral and ground.

Double-Y connections, Figs 6 and 7, usually give the least expensive protection. But this installation has too few capacitors in parallel to permit dividing them into the double-Y arrangement.

Measured microfarad capacitance values were marked on the name plate of each factory-assembled stacking unit. This permitted placing each stacking unit in position to obtain close balance of capacitor phases. Simple adjustments on the secondary

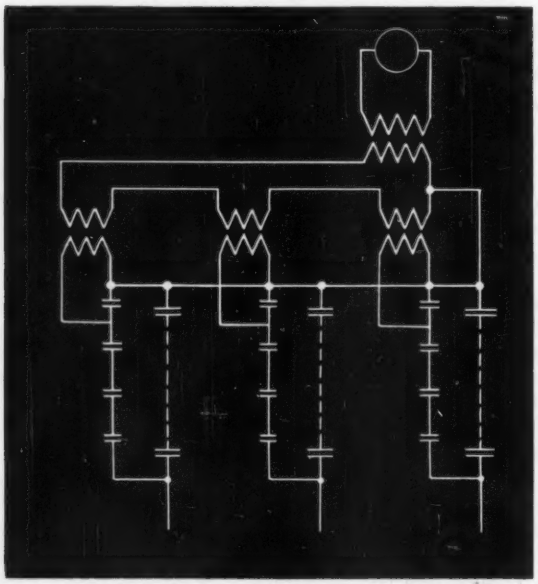


FIG 1—PHASE VOLTAGE UNBALANCE is detected with three capacitor potential devices and an insulating transformer

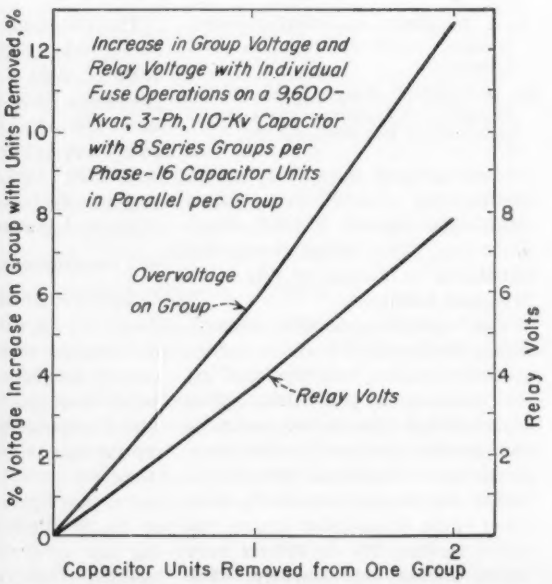

Increase in Group Voltage and Relay Voltage with Individual Fuse Operations on a 9,600-Kvar, 3-Ph, 110-Kv Capacitor with 8 Series Groups per Phase-16 Capacitor Units in Parallel per Group
Overvoltage on Group
Relay Volts
% Voltage Increase on Group with Units Removed, %
Relay Volts
Capacitor Units Removed from One Group
0
2
4
6
8
10
12
1
2

FIG 2—UNBALANCE RELAY detects overvoltage on remaining capacitors in group with one or two units disconnected

of the capacitor potential devices compensated for any remaining small unbalance. This gave the effect of perfectly balanced phase capacitance without extensive testing and interchanging of capacitor units.

The factory-assembled stacking units were supported at the base with 115-kv insulator stacks. Individual outdoor fuse holders are mounted on the horizontal buses above the capacitor units. A leaf spring connects each fuse link to its capacitor unit. One end of the spring is attached extending horizontally from the capacitor bushing. The outer end of the spring is bent up and attached to the cable of the fuse refill, thus placing the spring under tension. If the fuse operates, the spring ejects the cable end of the fuse link and inserts an air gap in the circuit so that no voltage remains across the fuse holder. The horizontal position of the spring, readily seen from the ground, serves as visual indication of fuse operation.

Capacitor potential devices are mounted on an insulated platform at the end of each capacitor phase. The 120-120-v insulating transformer, which looks like a high-voltage current transformer, provides insulation between the high-voltage capacitor connections and the unbalance detection relay circuit. The relay circuit is grounded for safety reasons.

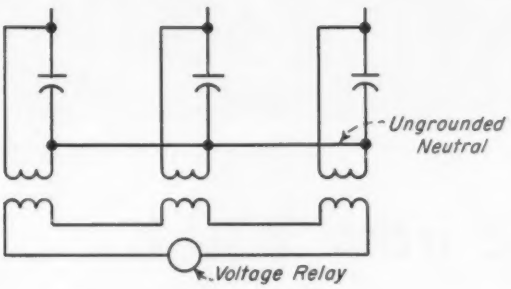


Fig. 3- Unbalanced Phase Voltage

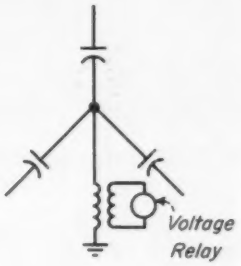


Fig. 4- Neutral Voltage

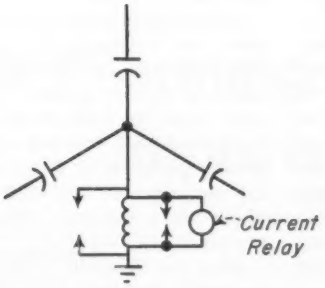


Fig. 5- Neutral Current

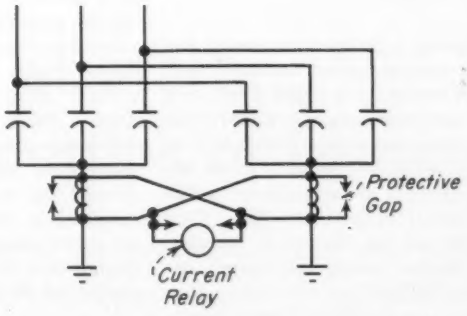


Fig. 6- Differential Neutral Current

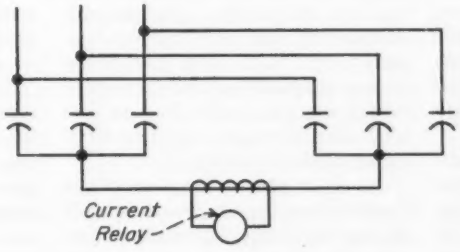
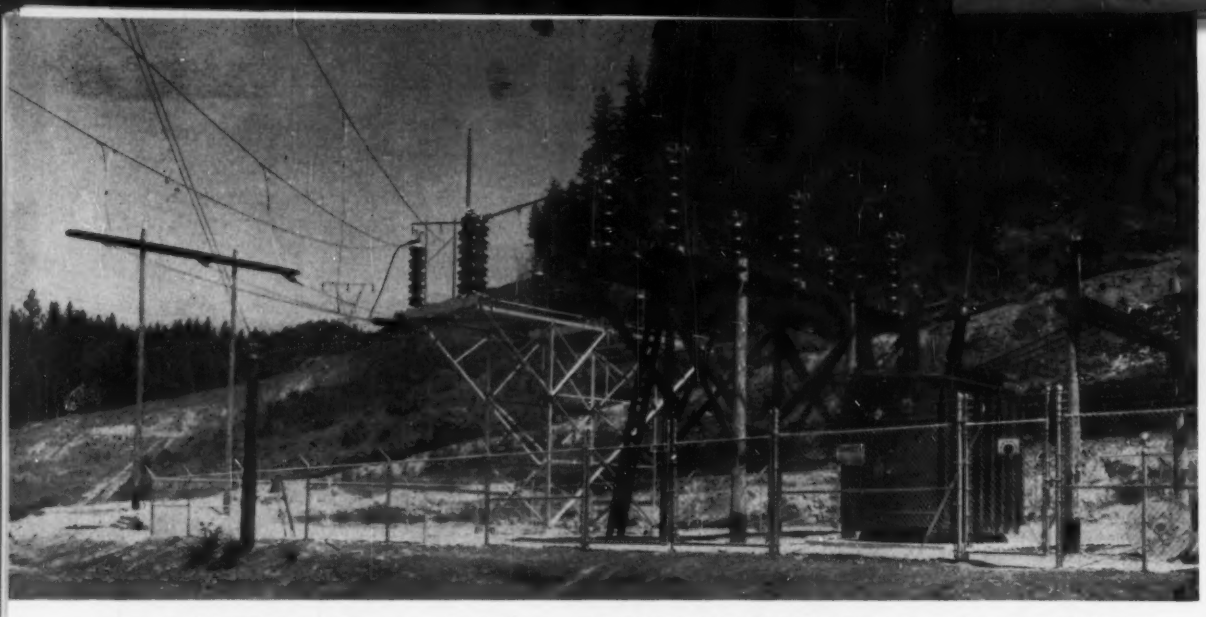


Fig. 7- Unbalanced Current Between Neutrals

ALTERNATIVE PROTECTION SCHEMES fall short of meeting protection requirements for 9,600-kvar capacitor. Harmonic current causes trouble in Figs 3, 4, and 5, and bank is too small for effective use of double-Y connection, Figs 6 and 7



Special 100-Amp Fuses and 3-Phase, 230-13.8-Kv, 2,500-Kva Transformer Help to . . .

Serve Mine Load from 230-Kv

R. C. SAFRANEK, Electrical Engineer,
R. C. KELLY, Asst Supt, Maintenance & Construction, Washington Water Power Co, Spokane, Wash.

Tapping a 230-kv transmission line is the solution applied by Washington Water Power Co to supply power to a lead and silver mine near Pend Oreille Lake in an isolated mountain area in northern Idaho. Feasibility of the tap was enhanced by designing and building special power fuses for 230-kv service and use of what is probably the smallest power transformer operating at 230 kv.

Need for a reliable power source was influenced by recurring failures of the isolated electric plant at the mine, which resulted in interruption of operations. Preliminary cost study by Washington Water Power covering 20 miles of distribution line over rugged terrain and a substation capable of furnishing an initial load of 900 kw indicated the job was not feasible economically.

A less-costly solution lay in the company's 80-mile, 230-kv transmission line between Cabinet Gorge Plant and Spokane, which crossed the mountains within four miles of the mine. Water Power decided to build a 230-13.8-kv substation adjacent to the transmission line and four miles of 13.8-kv line to the mine. Additional revenue is expected from resorts and summer homes on the lake.

To protect the transmission line, 230-kv power fuses were selected as an economical means of disconnecting the substation in the event of an internal fault or low-voltage bus fault. Fuses of the required rating were specially designed and built for this project. These units are rated 230 kv, 100 amp and are designed for an interrupting ability up to 1,500 rms symmetrical amp. Lightning spill gaps mounted on one end of the 196-kv air switch are of Water Power manufacture and are adjusted to a gap spacing of 40 in.

Size: Small; Weight: Light

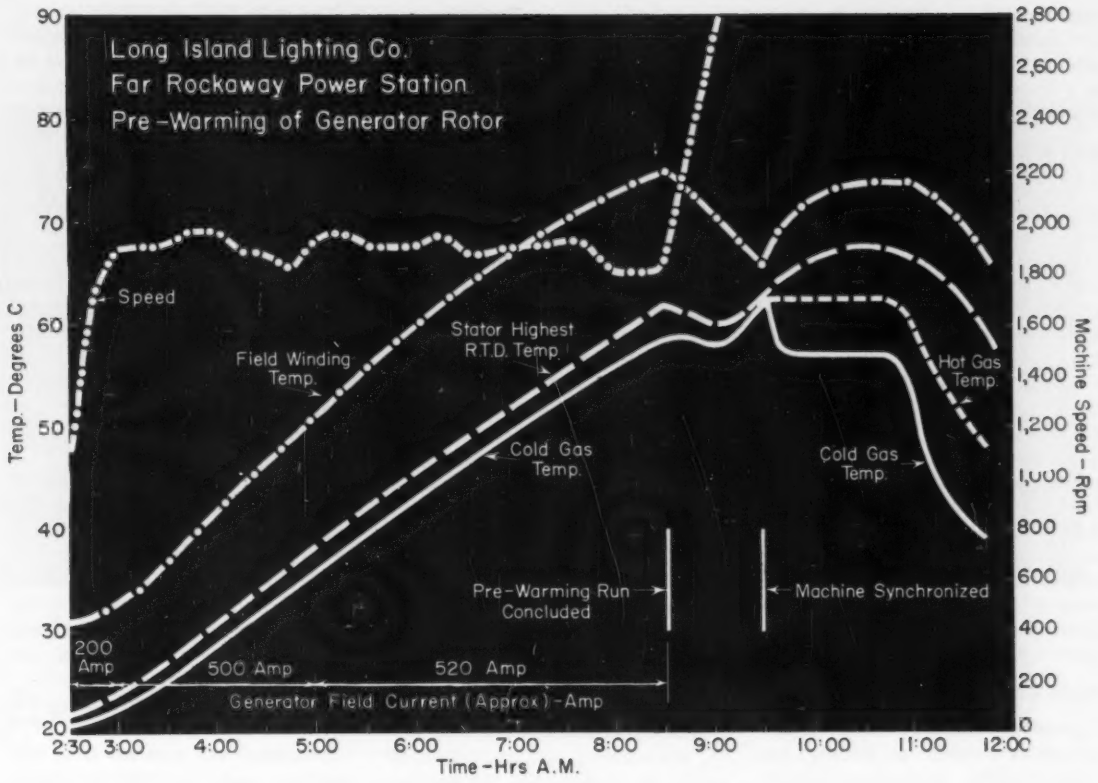
The 3-phase, 230-13.8-kv power transformer, rated 2,500 kva, is oil immersed, self-cooled with gas-oil seal and 900-kv BIL. The unit was designed for minimum size and handling weight to facilitate transporting it over mountainous roads. Shipping weight was just under 31 tons and total installed weight, including 6,500 gal of oil, is 104,100 lb.

An initial plan to barge the transformer across the lake was abandoned in favor of trucking it to the substation site because of unpredictable lake levels and sudden storms which are frequent in the area. The 23-mile trip on a 15-wheel trailer and truck from the railroad siding at Athol, Idaho, took three days. A second trailer tractor and a Cat tractor for pushing or braking were required over most of the route because of grades, some of which were 15%.

Many hairpin turns were negotiated after first bulldozing out an extra wide roadway. The journey was not, however, without mishap. The unit upset when the trailer broke through a crust of road covering an underground spring. Most fortunately, this did not occur at one of the many places where the road skirts a deep canyon.

After the transformer was righted, a careful inspection and meggering and turn-ratio tests showed that no damage was done other than a broken neutral bushing. As a precaution, war-surplus aircraft landing mats were used on remainder of the trip to spread the load over parts of the road made soggy by rains. There was no other trouble.

Substation construction crews were billeted at a resort six miles across the lake from the work. Transportation by launch to and from the job required one hour per day; whereas travel by motor vehicle would have taken three hours. Concrete for foundations and transformer slab was hauled 43 miles from Coeur d'Alene, Idaho, by a pre-mix company at less cost than mixing on the job. The substation was energized 36 days after construction began.



Pre-Warming Rotor at Starting Improves Properties of Forgings

GENERATION
Operation

LILC, following GE recommendations, gets rotor forgings to 55-60C before bringing cold generator up to full speed

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MARTIN LENNIG, General Electric Co, New York, N. Y.

Pre-warming large turbine-generator rotors during initial starting and on returning to service after outages with a direct-connected exciter is now routine procedure at Long Island Lighting Co. The procedure, recommended by General Electric Co, improves ductility and notch toughness of the rotor material during the starting period.

GE announced its recommendation four weeks before a scheduled shutdown of the utility's Far Rockaway power station's Unit No. 4. Accordingly, plans were made to pre-warm the rotor on returning it to service.

The initial recommendation stated that the temperature of the generator rotor forging should be raised to 55 or 60C before the cold machine was brought up to full speed. Field winding resistance, stator winding, and cold gas temperatures were substituted for rotor forging temperature for which there is no direct method of measuring.

GE recommended that the rate of temperature rise during the warming should not exceed 10C per hr and that the field winding temperature should not exceed 85 to 90C. A cold gas temperature and stator resistance temperature detector high reading of 60 to 65C would indicate the machine rotor is at the recommended temperature for being brought up to full speed.

For pre-warming, three alternative procedures were outlined:

1. Application of dc to the field winding.

2. Passing warm water in the generator coolers, thus reversing the normal cooling cycle.

3. Replacing the hydrogen in the generator with dry air or carbon dioxide to heat by windage.

With any of these procedures, it was recommended that the machine be limited to approximately half speed until the 55 to 60C temperature was reached. GE recommended that in using dc in the field winding the ap-

plied generator field current should not exceed that value which would give 115% of rated generator armature volts if the machine were operated at full speed.

Unit 4 Is Described

Unit No. 4 is an outdoor, tandem, 100-Mw, preferred standard machine, and the generator is rated 105,882 kva, 13.8 kv, 0.85 pf, 0.5 psig H_2. The direct-connected, gear-driven exciter is rated 290 kw, 250 v, 1,191 rpm, with an amplidyne voltage regulator.

Long Island Lighting decided that dc in the field winding was the most feasible method of pre-warming this generator rotor, as it would require minimum preparation. This meant that the geared exciter, operating at half speed, would be required to generate about half full output power. What remained questionable was whether the ventilation was sufficient to carry away loss heat. Thus, exciter cooling was expected to be critical.

Extra Cooling Not Needed

Possible ventilating system modifications were considered, auxiliary fans being available during the pre-warming. Actually, however, no special cooling was needed. The exciter ran at a temperature lower than was anticipated and has proved to be no cause of concern in any of the company's pre-warming runs.

Long Island Lighting determined from the generator saturation curve that it would take 570 amp to pre-warm the field as recommended. To determine whether the shaft-driven exciter could produce the desired voltage at half speed, a series of check points were observed immediately after the machine came off the line:

		Excitation	
Rpm	Kv	Volts	Amp
3,600	13.8	80	460

The field rheostat being left fixed as the machine slowed to half speed, the following readings were taken:

		Excitation	
Rpm	Kv	Volts	Amp
1,800	...	9	30

With all field resistance out and the machine at half speed these readings were taken:

		Excitation	
Rpm	Kv	Volts	Amp
1,800	...	20	100

As the exciter would not build up to the required output at half speed, a method, using the amplidyne, was developed to excite the field of the main exciter. A 1½-v dry cell was employed to excite the amplidyne main field. The cell caused the amplidyne to generate a boost voltage of approximately 150 v in the main exciter field circuit. A zero-150-ohm variable resistor and a milliammeter in the dry cell amplidyne excitation circuit afforded control of the boost voltage.

Unit No. 4 is of the unit design principle. The main power transformer cannot be readily disconnected from the generator leads. According to the manufacturer, no damage to the transformer would result, provided voltage was kept approximately proportional to frequency, not exceeding 57.5% of rated voltage at 30 cycles. On this information it was decided to leave the auxiliary transformer connected during pre-warming also. A disconnect switch for disconnecting the auxiliary transformer from the main generator lead circuit was left connected to minimize preparations.

Transformers Removed

Before pre-warming, as a precaution against damaging voltage regulator equipment at low frequencies, the voltage regulator potential transformers were withdrawn from their compartments. The amplidyne auxiliary fields were neither reconnected nor disturbed during pre-warming. All water to hydrogen coolers was shut off, and drain valves were opened.

On starting the pre-warming cycle, the machine was turned over in the normal manner. As machine speed approximated 1,200 rpm, the amplidyne motor was started in the "test" position and then put in the "run" position. The dry cell amplidyne excitation circuit was applied across the main field of the amplidyne.

Setting Left Fixed

Resistance was cut out of this circuit until the amplidyne was supplying 85-v boost to the main exciter field; this required 64 ma in the dry cell amplidyne excitation circuit. This setting was left fixed during the entire pre-warming.

The main field air circuit breaker was then closed, and the main exciter field rheostat was adjusted to give an output of about 200 amp. When machine speed was approximately 1,800 rpm (half speed), the main exciter field rheostat was adjusted to give an output of about 500 amp. Thereafter only minor adjustments were made.

Pre-Warmed for 5 Hr

Pre-warming was performed with 0.5 psig hydrogen in the generator. During the test, the generator field winding temperature was observed to be increasing at the desired rate of 5 to 10C per hr. The generator stator and gas temperature followed the same rate of rise but lagged about 13C. Pre-warming was continued for almost 5 hr. By this time temperature of the generator field winding had reached 75C, that of the stator 62C.

In accordance with existing recommendations, it was concluded that the rotor forging temperature was heated to the prescribed range and that the pre-warming was terminated.

Excitation Removed

Excitation was removed from the generator as well as from the amplidyne. The latter was stopped, and its main field reconnected. This was actually done by means of a double-pole, double-throw, knife switch of 10-amp capacity, added previously to the amplidyne circuit to permit pre-warming or normal regulation connections to be made with minimum effort. The voltage regulator potential transformers also were returned to their normal operating position.

Brought to Full Speed

The unit was then brought up to full speed in the usual manner, synchronized and loaded to approximately 10 Mw. At this time, the hydrogen cold gas temperature was about 62C. The water valves to the hydrogen coolers were opened slightly, lowering the hydrogen cold gas temperature by about 5C.

At 35-Mw load, a final adjustment was made to the water valves to lower the hydrogen cold gas temperature to normal, which is 40C.

In the six weeks following the successful pre-warming of the Far Rockaway power station, Unit No. 4, generator field forging, LILC repeated the procedure twice. Each of the other machines was of the same rating and design. Results were similar.

Analysis of Demands of 82 Homes in Pacific Northwest . . .

	Present Basis (National Electrical Code)	New Basis (Test findings)
Range, 12 kw	8	6
General lighting and small appliances	3 kw + 35% of excess	3 kw + 35% of all load in excess of 9 kw, including incidental space heating
Four or more fixed appliances	75% demand factor	
Space heating	No reduction	75% demand factor (fixed only)
Demand for 40 kw of connected load*	**27.35 kw**	**19.85 kw**

*Includes 5.4-kw of lighting and small appliances, 12-kw range and 6-kw oven, 4.5-kw water heater, 4.6-kw dryer, 1.5-kw air conditioning, 2-kw incidental space heating, and 4-kw of other fixed appliances.

Leads to This Question:

Are Present Methods of Calculating Service Demands Adequate?

DISTRIBUTION
Testing

NEC challenged. Test indicates only small fraction of high-wattage appliances' connected load shows up in demand

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GORDON F. DeFOE, General Sales Supervisor, Washington Water Power Co, Spokane, Wash.

A new basis is needed for the calculation of residential service demands to show more accurately the effect of the new high-wattage appliances on a customer's demand. Evidence is mounting which opens to question the value or accuracy of the National Electrical Code methods, especially as they apply to single-family dwellings. One basis for making these calculations is summarized and compared with the NEC methods in the table above. This new basis is the result of a recent analysis of service demands of 82 homes in Washington and Utah.

The present NEC recognizes a certain diversity of demand in residential usage. Section 2121 provides for an 8-kw demand for a 12-kw range. Section 2203 provides for a demand of 3 kw plus 35% of the connected design load over 3 kw for general lighting and small appliances. Sub-section "e" states that a 75% demand factor may be applied for four or more fixed appliances, excluding space heating equipment. However, the statement ". . . that a 75% demand factor may be applied . . ." usually is interpreted that it shall be applied. In contrast with these code specifications, it is found that only a small fraction of the connected load of the high-wattage appliances is observed in the customer's service demand.

This same effect of new connected load has been found in industrial and commercial loads. Thus, it was thought desirable to investigate the present relation between connected loads and service demands of residential customers. A study team for the investigation, sponsored by the Inland Empire Electrical League, included members of the National Electrical Contractors Association, the electrical inspection division of the city of Spokane, Wash., the local electric utility, and a professional engineer.

Data Reflects High Use

The study applies primarily to residential customers in the Pacific Northwest, 90% of whom use electric ranges and water heaters and a high percentage use electric dryers. Test data were obtained for 67 homes in Spokane. Of this number, monthly demands covering over two years of operation were obtained for 49 homes, and during the past winter season for the remainder. All homes have electric ranges and water heaters, and most of them have clothes dryers. Data from 15 additional homes, ten

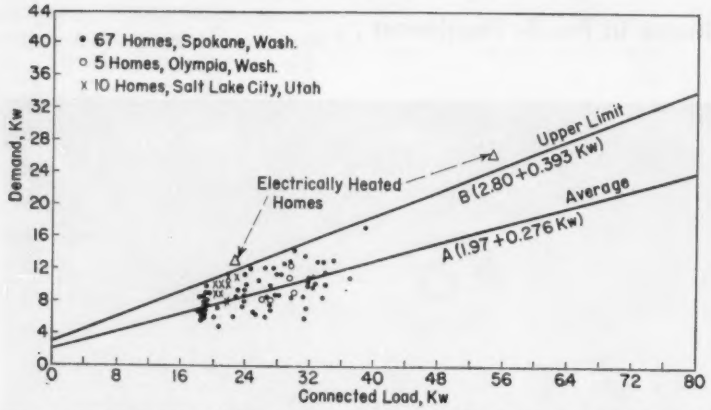


FIG 1—DEMAND CURVES for 82 homes in the Pacific Northwest are Curve A, average demand, and Curve B, upper limit of demand. Highest demand of 17.2 kw was recorded for a home with a 38.9-kw connected load, highest among test homes

Table I—Analysis of Five Test Homes Using 9 Kw Base Load

Test Home	1	2	3	4	5
Connected Load, kw					
General lighting and small appliances	3.9	3.9	6.75	5.1	6.9
Range	12.0	12.0	12.0	12.0	17.0
Water heater	2.5	2.5	3.3	4.5	5.5
Dryer	.....	4.5	4.7	4.7	4.7
Freezer	.....	.....	0.24	0.24	0.24
Furnace	0.48	.....	0.48	0.48	0.48
Unit heater	.....	.....	1.6	3.9	3.6
Refrigerator	0.21	0.25	0.21	0.21	0.21
Automatic washer	.....	0.28	0.28	0.28	0.28
Total connected load (1)	19.1	23.4	29.6	31.4	38.9
Less 9-kw base load (2)	10.1	14.4	20.6	22.4	29.9
Test demand, kw (3)	10.0	12.0	12.7	13.5	17.2
Less 9-kw base load (4)	1.0	3.0	3.7	4.5	8.2
Ratio (4)/(2)	0.099	0.208	0.180	0.203	0.274
Equivalent demand factor (3)/(1)	0.524	0.513	0.43	0.429	0.441

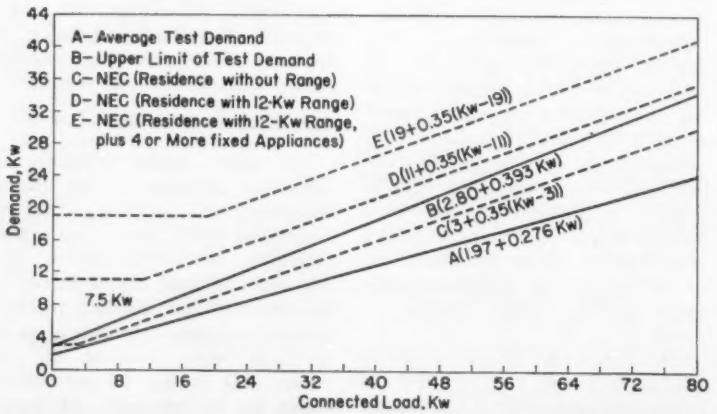


FIG 2—TEST DEMAND CURVES show the average and maximum test demands for 67 homes and demands as calculated by NEC methods. Curve D is about 18% higher than Curve B; Curve E is about 25% above maximum test Curve B

in Salt Lake City, Utah, and five in Olympia, Wash., also were obtained.

Test data for each home included indicated demand on the service, consumption, connected load, total floor area, and dollar value. The connected load included an allowance of 3 w/sq ft of floor area, 1.5 kw for small appliances, and name plate ratings of ranges, water heaters and other large appliances. Data were analyzed for the relation of the observed demand to (1) connected load, (2) floor area, (3) largest single connected load, and (4) dollar value of the residence. Load factor (ratio of kwhr to kw demand) was determined, and winter and summer demands were compared.

Highest Demand 17.2 Kw

Average connected load for the 82 homes was about 22 kw, varying from 18.5 to 38.9 kw. About 17% had connected loads of 30 kw or higher. Average demand was equal to 1.97 kw plus 27.6% of connected load. This expression is shown as Curve A in Fig 1. The highest demand **ratio** was 12 kw for a home with a connected load of 23.4 kw (51.3% demand factor). Curve B in Fig 1 plots the upper limit of demand, which is equal to 2.8 kw plus 39.3% of connected load. The highest **demand** was 17.2 kw for a connected load of 38.9 kw, the highest connected load found. Connected loads in the five homes having the highest demands are shown in Table I.

Analysis of data resulted in these conclusions relative to the characistics of the residence. There is no apparent correlation between service demand and floor area. This follows the predominant use of large appliances. No correlation could be found between service demand and the largest single unit load because the unit load was about constant. The largest single unit load was about 4.6 kw, usually a large oven, dryer, high-recovery water heater, or space heater. Range load was considered to consist of several unit loads—one or two ovens and the top elements.

No Relation to House Value

No relation is apparent between service demand and value of the residence. Homes valued at $7,500 and less had demands of 5.3 to 12 kw; the $10,000 to $20,000 class had demands of 6.2 to 13.5 kw; and the $20,000 to $35,000 class, demands of

6.0 to 17.2 kw. There appears to be no connection between maximum demand and consumption in any particular month. Monthly load factors ranged from 5.2 to 32%.

December and February demands were the highest for the average as well as the upper 10% of the homes. Average demand in December or February was 7.2 kw and 6.5 kw in June or July. The upper 10% of a 56-home group had demands of 10.6 kw in January and 8.8 kw in July, a winter-summer ratio of 1.2.

Demand curves determined by the tests and approximate NEC demand curves are plotted in Fig 2. Curve A shows the average test demand for the 67 homes, and Curve B, the maximum test demand. Note that the equations for the curves use total connected load and not the connected load in excess of 1.97 or 2.80 kw. Curve C shows the NEC standard (residence without range) of 3 kw plus 35% of connected load in excess of 3 kw. Curve D shows the NEC standard of 3 kw plus 8 kw for a range plus 35% of connected load in excess of 11 kw. Note that Curve D is about 18% above maximum test Curve B for the higher group of tests having an average connected load of 32 kw. Curve E shows a possible code calculation for a home having a range and 12 kw in four or more fixed appliances. Base load for Curve E is 19 kw—3 plus 8 (range) plus 8 (fixed appliances)—plus 35% of the connected load in excess of 19 kw. This curve is about 25% above the maximum test curve at 49.4 kw of connected load.

35% Factor for Fixed Units

Test data indicate that fixed and semi-fixed appliances, with the possible exception of large space heaters or similar unit loads, should be taken as adding 30-35% of the connected load to the service demand. Thus, the addition of a 4.6-kw clothes dryer may show up as an increase of 1.4 to 1.6 kw in the maximum demand.

Graphical analysis of Curve B in Fig 2 gives a base load of 7.5 kw if a 12-kw range load is deducted from the connected load. If 3 kw of this 7.5-kw base load is assigned to general lighting and small appliances, then 4.5 kw is the normal range demand established by the tests. This is about equivalent to a large oven or a "speed" top plate.

In view of this normal range de-

Table II—Analysis of Five Test Homes Using NEC Calculation

Test Home	1	2	3	4	5
Connected load, kw*	19.1	23.4	29.6	31.4	38.9
Less range and 3-kw base load	15.0	15.0	15.0	15.0	20.0
Excess load	4.1	8.4	14.6	16.4	18.9
Calculated Demand					
35% of excess load	1.43	2.95	5.1	5.75	6.62
Base load	3.0	3.0	3.0	3.0	3.0
Range	8.0	8.0	8.0	8.0	8.0
5% per kw of excess range	.....	.....	.....	.....	2.0
Calculated demand (2)	12.4	13.95	16.1	16.75	19.6
Actual demand (3)	10.0	12.0	12.7	13.5	17.2
Ratio (2)/(3)	1.24	1.16	1.26	1.24	1.14

* See Table I for breakdown of connected load

Table III—Future Loads of Five Homes

Sample Homes	A	B	C	D	E
Floor area, sq ft	1,000	1,000	1,500	2,000	3,000
Connected Load, kw					
General, 3 w/sq ft	3.0	3.0	4.5	6.0	9.0
Small appliances	1.5	1.5	1.5	1.5	1.5
Water heater	1.5	4.5	4.5	4.5	9.0
Dryer	4.6	4.6	4.6	9.2	9.2
Freezer	....	....	1.0	1.0	2.0
Furnace-boiler	1.0	1.0	1.0	1.0	1.5
Unit heater	1.0	1.5	3.0	3.0	4.5
Duct heater	....	....	3.0	5.0	7.5
Air conditioner	....	1.0	....	....	....
Shop	....	....	1.0	1.0	2.0
Range	10.0	15.0	17.2	17.2	17.2
Oven	....	....	....	....	6.0
Total connected load	22.6	32.1	41.3	49.4	69.4

Table IV—Analysis Compares NEC and Recommended Calculations

Sample Homes	A	B	C	D	E
NEC Calculation (Using 35% of excess load)					
Total connected load, kw*	22.6	32.1	41.3	49.4	69.4
Connected load less range	12.6	17.1	24.1	32.2	46.3
Less 3-kw base load	9.6	14.1	21.1	29.2	43.3
35% of excess load	3.4	4.9	7.4	10.2	15.2
Base load	3.0	3.0	3.0	3.0	3.0
Range	8.0	8.0	8.0	8.0	8.0
5% per kw of excess range	....	1.2	2.1	2.1	2.1
35% of oven load	....	....	....	....	2.1
Demand load	14.4	17.1	20.5	23.3	30.4
Recommended Calculation					
Total connected load, kw*	22.6	32.1	41.3	49.4	69.4
Deduct 9-kw base	13.6	23.1	32.3	40.4	60.4
35% of excess	4.8	8.1	11.3	14.1	21.1
Add 9-kw base	9.0	9.0	9.0	9.0	9.0
Demand load	13.8	17.1	20.3	32.1	30.1

* See Table III for breakdown of connected load

mand, the code value of 8 kw for a 12-kw range might be reduced to 6 kw. This can be done providing the newer range "speed" units do not materially exceed a 6-kw pre-heat rating. If this reduction is accepted, then a 9-kw base load for the average home would be used. A percentage of the connected load in excess of 9 kw would be added to the base load to give the service demand.

Covers 40 Kw or Less

Analysis of Curve B on this basis gives 9 kw plus 30% of the connected load in excess of 9 kw, or an 18.3-kw demand for 40-kw connected load. This analysis should satisfy all loads below 40 kw but may prove inadequate when residential connected loads exceed 50 kw. Table I analyzes the five highest test demands using this method.

Table II analyzes these five highest demands using the present NEC method, without recognition of the 75% demand factor for four or more fixed appliances. The test data show that the NEC method is too conservative for present-day residential connected loads. It is recommended that the 75% demand factor should not apply to fixed appliances in residences. These appliances should be calculated on the same basis as other excess loads. It is further recommended that auxiliary space heaters in non-electrically heated homes be included with excess loads.

Higher Base for 6 Kw Loads

Service demands to reflect present-day conditions, based on recommendations offered by the authors, would be calculated in this manner: Connected load—3 w/sq ft of floor area for general lighting, 1.5 kw for small appliances, 12 kw for range, plus the sum of all other connected load. Service demand—9 kw plus 35% of all connected load in excess of 9 kw. This exception should be noted. Where the largest single unit load, such as range oven, separate oven, air heater, water heater, etc, exceeds 6 kw, then the base load of 9 kw should be increased by the amount the unit load exceeds 6 kw.

Possible connected loads in five homes of the future are listed in Table III. The service demands of each of these are calculated in Table IV, using two methods. The first is the accepted NEC method for general lighting and small appliances and range demands but using a 35% demand factor for all excess loads. Note that the range load is not included in the excess loads. The second method is the recommended calculation of 9 kw plus 35% of all load in excess of 9 kw. Data from Table IV are plotted in Fig 3, with Curve B from Fig 2 shown for comparison.

Test data for 64 all-electrically heated homes are plotted in Fig 4. These data cover two years of operation during which time the degree-days were about 6% above normal, and temperatures of −3 to −12 F were recorded. Design temperature for the locality is −15 F.

75% Heating Factor Adequate

Expression for the maximum demand in Fig 4 is 1.13 plus 0.61 kw. Analysis shows that demand can be expressed as 4.58 kw plus 81% of the connected heating load, plus 33% of connected appliance and lighting load. If the base load is increased from 4.58 to 9 kw and the excess appliance and lighting load calculated at 35%, then 75% for electrical space heaters appears adequate. Maximum test Curve B (Fig 2) and theoretical Curve F (Fig 3) are shown for comparison.

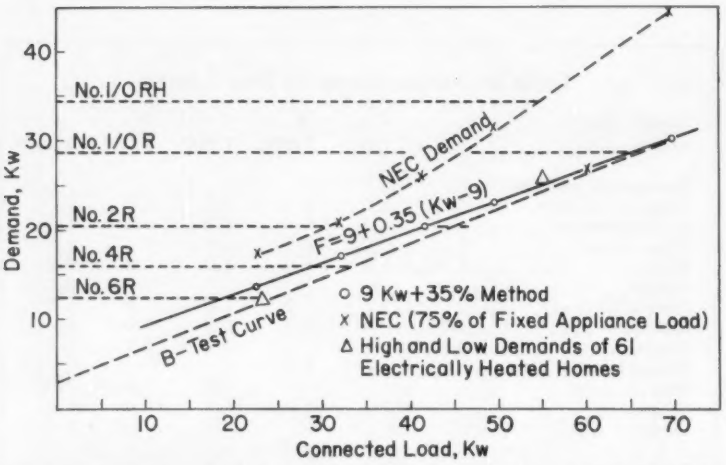


FIG 3—FUTURE DEMANDS of five sample connected loads are calculated on the basis of the method recommended by the authors, Curve F, and the present NEC methods. Note the agreement between Curve F and the maximum test Curve B

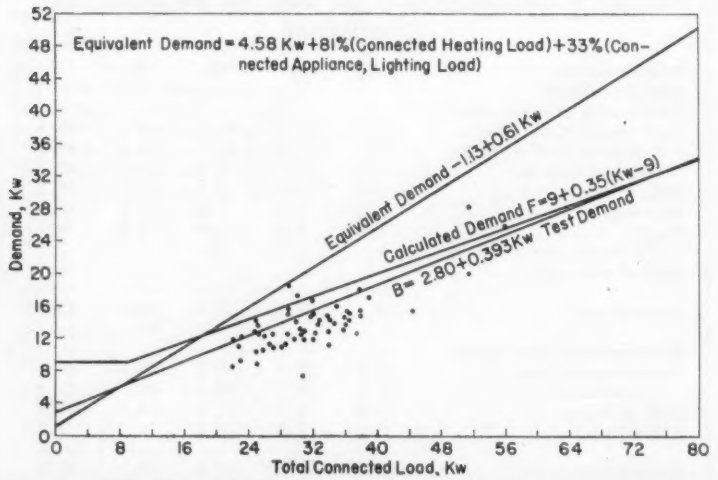


FIG 4—EQUIVALENT DEMANDS of 64 all-electrically heated homes are compared with test Curve B and demand Curve F. If demand expression uses 9 kw as base load, and 35% of excess load, then 75% for space heating appears adequate

4th Steam Station Design Study

Few radical changes are evident, but new ideas are appearing mostly in large-unit plants. Steam pressures and temperatures are still going up

JOHN J. KEARNEY, Associate Editor

This survey confirms the existence of some trends in new design noticed in the previous survey (EW, Oct. 18, 1954) and the arrival of additional new design ideas. All of these trends of course are dictated by economic considerations and efficient operation. However, quite a number of them are directly related to the increase in unit size.

Increase in unit size is largely responsible for:

1. Increase use of cross compound machines.
2. Use of non-motor driven boiler feed pumps.
3. Use of more than one main power transformer.
4. Use of FOW cooled main power transformers.
5. Continued trend to higher generator voltages.
6. Conductor cooled generators.
7. Use of liquid as a stator cooling medium.
8. Motor driven exciters.
9. Two strings of high pressure heaters.

Examination of electrical plant design details also shows the following interesting trends:

1. More use of cable trays and racks to support auxiliary power cable.
2. Power and control cable in same cable tray.
3. Greater use of aluminum for generator main leads and switchyard buses.
4. An increase usage of microwave.

Mechanical plant designers are using many of the new ideas and equipment developed in recent years, such as:

1. Controlled circulation.
2. Pressurized furnaces.
3. Reheat cycle.
4. Demineralization for feedwater makeup.

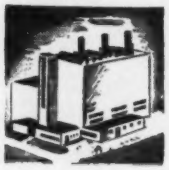
Also of interest is the swing toward deaeration of feedwater in open heaters, smaller coal bunkers, and an apparent saturation in the number of plants designed for outdoor operation.

Comparison with the previous survey does not indicate any radical departure in design features of the majority of the reporting plants. The short space of two years precludes any such abrupt changes in design practices, but the trends mentioned above confirm the continuing progress in station design.

Following is a detailed analysis of 202 items of 67 modern power plants.

Reprints of this article and the check chart following are available at a nominal fee. Address:—Electrical World, 330 W 42nd St., New York 36, N. Y.

General Features



All but 15 of these modern power plants use either one or two operating levels. Forty-three of the plants were designed with a conventional type of layout.

Outdoor plants are still in favor with plant designers as a means to cut costs. And some claim that this type construction provides greater operator comfort in certain areas of the country. But the trend to an increasing use of outdoor plants seems to have stopped. The amount of equipment placed outdoors today seems to be about the same as was reported in Electrical World's Third Steam Station Design Survey (Oct. 18, 1954). The following comparison indicates this static condition.

Equipment Outdoors	3rd Survey (65 plants reported)	4th Survey (67 plants reported)
Boiler	31	34
Turbine	19	16
Fans	43	38
Pumps	18	11
Air Heaters	30	34
Dust Collectors	31	33

A surprisingly large number of stations in the Middle Atlantic and Mountain regions reported equipment outdoors.

Dual air heaters, dust collectors, and fans are used by almost all stations. But the increasing unit sizes may change this picture. One station reported using four air heaters and four induced-draft fans with a 335-Mw unit.

Almost half of the stations have forced air ventilation. Forty-eight stations use grating floors. This is about the same proportion as in the 1954 Survey.

Another finding similar to the 1954 Survey was the number of stations reporting quick load pickup—20% in both surveys.

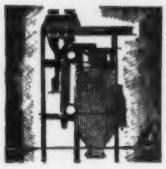
External walls are of brick, aluminum, and cement-asbestos. The ratio of use being 4:3:2. Seventeen stations reported using more than one type of material.

About half of the plants use steel stacks. This type of construction is particularly prevalent in the West South Central region where short stacks can be used because lower carry-over problems are experience with the burning of gas. Where dispersion is a problem and greater stack height thus required, concrete stacks are the choice three to one over brick stacks.

Fuel and Handling

Ninety-three per cent of the coal-burning stations use earthmoving equipment for both fuel piling and reclaiming. Two-thirds of these plants used bowl pulverizers. The last survey showed that most plants using coal had a bunker capacity for 30 to 50 hr of operation. In this survey the majority of coal-burning plants were designed with bunkers with a 20 to 40 hr operation capacity. Also indicated in this survey were a few plants using small bunkers (about 14 hr operation capacity) with a ready coal pile.

Steam Generator



Eighteen plants using twin-furnaced steam generators were reported. All but a few of these units were 150-Mw or larger. The future will undoubtedly see greater use of this design as unit size increases.

Four cyclone-furnace steam generators were reported. All are located in different areas of the country. Twenty-one plants reported using pressurized furnaces. This is a 50% increase in the number reported in the last survey. As in the last survey most are in the West South Central region.

About half of the plants use more than one means to control superheat outlet temperature. And 80% of the units with reheaters use more than one means for reheat control. The spray method is the most often used for both types of control (45 out of 67 for superheat, 36 out of 50 for reheat). Twin furnaces are used as a reheat control means in eight plants, most of which have large units. Forced circulation was reported for 12 units compared with seven in the last survey.

Television equipment is found in about half of the stations (same as in 1954). Thirteen of the plants use it for reviewing more than one object. Burners and boiler drum level gauge have equal interest to plant operators while stack discharge is viewed in only two plants.

All but one station reported one boiler per turbine. The one station (No. 12) uses three boilers for one of its units. But this arrangement is necessary because of process steam demands on the station.

Steam pressures and temperatures continue to climb. Only 8 of 66 reporting stations produce steam below 1,000 psi. And one station (No. 30) utilizes steam in the supercritical range—3,500 psi. Two use 2,350-psi steam, and five have steam pressures of 2,400 psi.

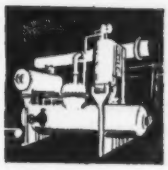
Eighty per cent of the stations report temperatures of 1,000F and above. Three report 1,100F. Reheat units continue to increase in use. Last survey 35 out of 65 stations used reheat. This year 50 out of 67 are reheat units. An increase in usage of about 40%.

Ash Control and Disposal

Every plant having soot blowers uses the retractable type but one. Straight mechanical precipitators are used more often than electrical ones or a combination of electrical and mechanical collectors. Two stations (Nos. 4 & 39) reported placing the precipitator before the air heater instead of in the usual position in the duct work between the air heater and the stack. Electronic rectifiers are preferred 3 to 1 over the rotary type as a source of dc for the electric precipitators.

Only 4 out of 38 utilities responding to the questions on fly ash indicated that they sold this boiler waste material. This is surprising in view of the potential market for fly ash reported at Electrical World's Conference on the uses of fly ash (EW, Aug. 27, p. 16). Fly ash from all four of these plants was sold in bulk. In addition it was packaged for concrete at two of the stations and packaged for asphalt fill at another.

Heat Cycle Apparatus



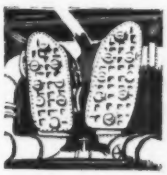
Demineralization has increased by leaps and bounds as a means to purify feedwater makeup. Utilities now use it as much as all other means combined. It was not reported in use in the First Steam Station Design Survey (1950) but it has increased in usage as follows in subsequent surveys: Second survey (1952) 13% of the replying plants used demineralization, in the Third, 43%, and in this survey 57%. Some economic studies indicate that demineralization is justified in multi-unit installations. Replies in this survey indicated that number of units in a station does not seem to be a factor in the selection of this type of water purification equipment. Demineralizers are used as often in single-unit as in multi-unit stations. But it is possible that the demineralizers in the single-unit stations were justified on the basis of future additions.

Group bypassing of heaters has been used by some designers as a means to reduce the initial investment in bypass piping and valves. High pressure heaters are bypassed three times as often as low pressure heaters. Fourteen stations bypass both types. A coming trend in cycle arrangement is the provision of two strings of high pressure heaters. Fourteen large stations use this method.

Condensing, Cooling Water

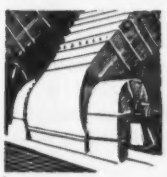
Fourteen stations are equipped with cooling towers. All of them are the induced fan type. Fourteen plants have provided corrosion protection at the intake, and 17 have provided this type of protection in the condenser. Two plants have insulated tube sheets.

Condenser



About half of the replies indicated locating heaters in the condenser throat. Four plants reported putting as many as three heaters in this space. The trend seems to be toward deaeration in open feedwater heaters rather than in the condenser. About half of the reporting plants remove air from the feedwater in open heaters, another 11 use both an open heater and the condenser, and 18 use condenser deaeration only. Almost five out of six plants use some type of copper alloy for condenser tubes. But nine are using aluminum alloy tubes probably with the hope that the lower first cost will result in a more economical arrangement if tube replacement does not become excessive.

Fans and Pumps



Seventy-five per cent of the plants use mechanical fan couplings—same as in the 1954 Survey. Eleven plants use hydraulic couplings. One of three plants (no change from 1954 Survey) use gas recirculating fans. One per boiler is usually used.

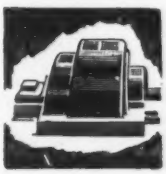
All but one station reported motor driven boiler feed pumps. However four plants also use turbine driven feed pumps, and two stations attach these pumps to an extension of the main turbine generator shaft. All of these exceptions are for large units. Use of such drives will undoubtedly increase.

The number of plants using three half-capacity feed pumps has decreased slightly. In the survey about 55% of the plants reported three pumps, in the 1954 Survey the figure was 70%. Use of other than motor drives contributes to this change, but probably a greater confidence in boiler feed pump reliability and a desire to reduce capital investment are mainly instrumental in the slight shift toward less than three pumps per boiler.

Piping and Valves

About one-third of the main steam lines do not have a valve between the superheater outlet and the main turbine stop valve. Provision for averting piping freeze up is made in 43 stations—23 do this by special routing of the pipes involved, and 22 use electric heating. There is a four-to-one preference for mineral insulation over aluminum shell as a means to insulate high temperature piping. This is the ratio that has existed in the last two surveys.

Turbine



As would be expected because of larger unit size, there has been an increase in the use of cross compound machines. Six were reported as against two in the previous survey. Use of larger units should see a continuation of this trend. Nineteen plants have quick start provisions; 23 units have thermal protection against motoring.

Generator

Unit size has increased to such a point that there is a slight trend back to the use of more than one main transformer per generating unit. Some designers do not want to tie up large blocks of power in one transformer. About 70% of the plants still use the unit system, but this is a decrease from the previous survey. Eleven plants report two, 3-phase transformers per unit, and five report three, single-phase transformers per unit. Most are for large units.

The dominate generator voltage indicated is 13.8 kv. But the definite trend to higher voltages noticed in the last survey continues. Voltage of 50 per cent of the stations exceeds 13.8 kv. This includes five at 20 kv, two at 23 kv, and one at 24 kv.

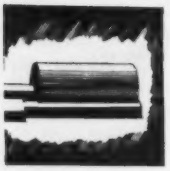
Other noticeable trends include conductor and liquid-cooled machines and use of aluminum for generator main leads. Copper is still the main conductor material for generator leads, but approximately 30% of the stations have aluminum bus. Seven of the 18 units with aluminum bus use welded bus construction.

Of 67 units 55 are conventional cooled and 12 conductor cooled. Nine of the 12 use hydrogen as the coolant. The remaining three have liquid cooled stators. The survey also shows that 11 machines have conductor-cooled rotors.

Two out of three plants locate hydrogen cylinders outdoors for safety. And almost all stations have stator and rotor temperature recorders. Those that do not, have temperature indicators.

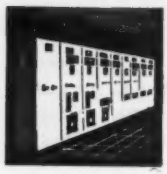
Fifty units have isolated phase main generator leads. Fourteen stations have field fabricated enclosures for the leads. Protection for loss-of-field is provided at 48 stations; against negative sequence current at 37 stations. Five out of seven stations have the generator neutral grounded through a distribution transformer.

Excitation



Almost 30% of the main exciters are motor driven. All but four of the units having motor-driven exciters are rated 150-Mw or more. This indicates a greater use of motor-driven exciters as average unit size increases. About half of the plants have a spare motor-driven exciter—same as in the 1954 Survey. And 36 (a 50% increase over 1954 Survey) have provisions for transferring exciter sets under load. The same number of plants have regulation protection against loss of potential source.

Station Auxiliary



Step-down transformers supply the station auxiliary power in 56 plants. There were no reports of shaft-driven house generators. Auxiliary voltage in today's modern plant is either 4,160 v (34 stations) or 2,400 v (30 stations). The use of grounded or ungrounded systems usually depends upon the voltage—grounded systems at 4,160 v and ungrounded systems at 2,400 v. However there are excepts—two 2,400-v systems were solidly grounded, and seven 4,160-v systems were ungrounded. There were 13 resistance-grounded systems. All of them operating at 4,160 v. The unit system still prevails in the layout of the station auxiliary system. But the appearance of larger unit sizes is bringing about a desertion of this principle—and use instead of two (15 plants) and three (3 plants) auxiliary buses and transformers. Almost all of these auxiliary transformers are oil-cooled while about half of the smaller station service transformers are the dry type. Motors as large as 4,000-4,500 hp are being used at 4,160 v. One station (No. 16) reported a 6,000-hp motor, but no operating voltage was indicated.

The question of automatic transfer of auxiliaries seems to split the ranks of electrical designers. Twenty-nine favor instantaneous transfer while a slightly lower number (23) prefer a time delay transfer.

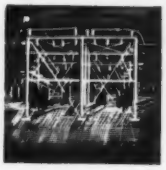
Putting control cables in trays is now standard practice. But this survey pointed up two significant trends in the present use of cable trays. One is the use of trays for power cable (reported at 43 stations), and the other is the practice of putting power and control cable in the same tray (26 installations). In addition to cable trays utilities used duct (29 cases), pipe (22), and racks (8) to run power cables (all 8 using armored cable).

Control Instrumentation

Most stations have central control rooms. And in most of these two units are controlled from a single control room. However, it is not wise to generalize on this arrangement because a number of these units are two-unit stations which leave the possibility of using the same room for control of future units. In fact three utilities report three units per control room, and an equal number report four units. Benchboards are used in about two out of three plants for turbine, generator, and auxiliary controls. Polyethylene and polyvinylchloride-insulated control cables are used at a little less than half of the reporting stations. The same is true of non-metallic sheath cable.

Leased telephone lines are used in most generator plants as a means of communication with the system, and then carrier and microwave equipment in that order. But there has been a 50% increase in the amount of microwave equipment used in the last two years. Some type of asbestos-covered cable was reported by most utilities in answer to the question about type cable in high temperature locations. Eight stations use mineral-insulated cable.

Outgoing Substation



Forty-two main power transformers are of the FOA type. But five are reported as FOW with all of these used on units 138 Mw and larger. Only three utilities reported tap changing under load (not indicated in the check chart). Five out of seven plants have fire protection for the main transformer. Water is generally the choice for the protecting medium.

The increased use of aluminum is not limited to generator main leads but has also extended to switchyard buses. In fact here its ratio of use is even greater with copper, however, still the choice 3 to 2. About half of the aluminum-bus switchyards use welded-type construction.

Pressure relay attachments on main power transformers are used for alarm purposes by 34 utilities, tripping by 16, and alarm and trip by 5. Almost all main power transformer (50 out of 56) are protected by lightning arresters.

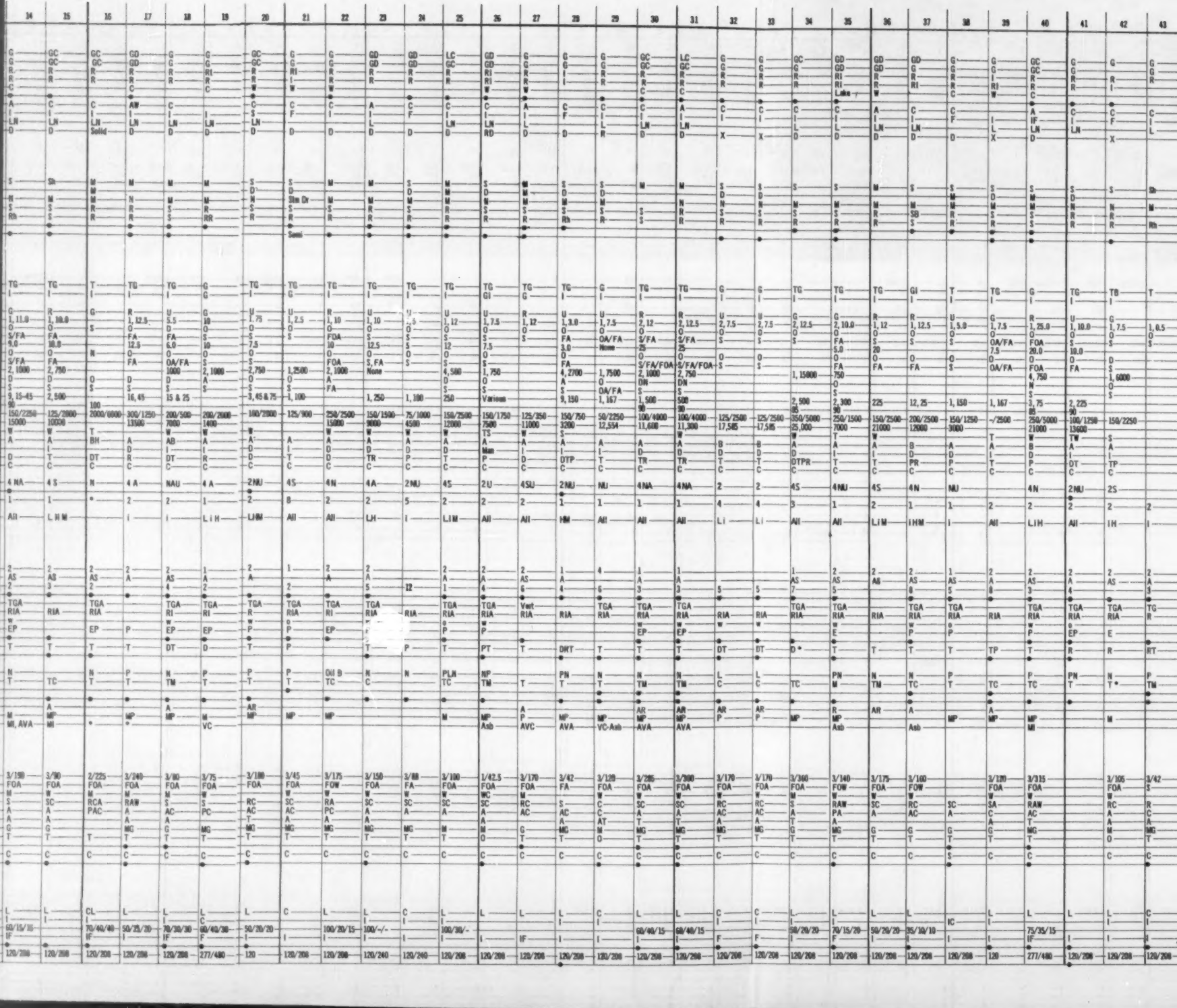
Lighting

Lighting engineers are making increased use of luminous ceilings for control room lighting—50% of the reported installations in 1952, 75% in 1954, and 83% today. Almost all lighting circuits are 120/208 v. A tabulation of the preference indicates 120/208 v—46 cases, 120/240 v—4 cases, and 277/480 v—2 cases.

Electrical World's Fo

Plant Number	1	2	3	4	5	6	7	8	9	10	11	12	13
Generator													
Stator cooling (G)as, (L)iq; (D)ucts, (C)onductor	G	G	G	G	GC	G	GD	GC	G	G	GD	LC	GC
Rotor cooling (G)as; (D)ucts; (C)onductor	G	G	G	G	GC	G	GD	GC	C	G	GD	GC	GC
Stator temp (R)ecorder (I)ndicator	I	RI	I	R	R	R	R	R	R	I	R	RI	RI
Rotor temp (R)ecorder (I)ndicator	R		R	R			R	R	R	I	R	RI	RI
(C)ondensate (W)ells cools hydr	W		C	C	C	C				C		C	C
Hydro cyl. OD for safety							•	•	•		•	•	•
Gen. leads (C)opper, (A)lum, (W)elded	A	C	A	C	C	C	C	C	AW	C		AW	AW
Gen. leads (I)so-ph, (S)epr-ph, (F)ield fabricated	I	I	I	Cable	I	I	I		I	I	I	I	I
Prot. for (L)oss of field, (N)egative sequence current	L	LN	N	L			LN		L	L	N	L	L
Neut. grded (R), (X), (D)lta tal	D	D	D	•	D	D	R	R	R	D	D	R	R
Excitation													
Main exc (S)haft driven, (M)g, (S)tatic	Sh	S	S	S	S	S	M	M	M	M	S	M	M
Pilot exc (D)irect comn. (M)g set		M	D		M	M	M	M	None	M	M		
Spare exc (M)otor driv. (N)one	N	N		M	M	M	M	M	M		M	M	M
Exctr. Excts. (S)elf, (B)attery (R)ot reg	SR	R	S	S			S	S	R	R	SR	S	S
Field regn (R)heo, (S)tatic (R)otating Amplifier	R	R	RA	R	R	R	R	R	S	R	Ro	Ro	Ro
Sets transfered under load				•	•	•	•	•	• Man	•	•		
Regulation protected against loss of potential source	•		•	•		•	•	•				•	•
Station Auxiliary Power													
(S)haft gen; (T)sfm off (G)en leads or (B)us	TG	TG	TGB	G	TG	TG	TG	B	TG	T	TG	TB	TB
Res. source (G)en bus, (I)ncom bus	I	I	I	I	I	I	I	I		I	I	I	I
Aux System (U)ndergrounded; (G)rounded directly, (R)esistance grounded	U	U	R	U	U	U	G	G	G	U	U	R	R
Aux Tsfm; No. per generator, mva	1, 5.0	2.5	2, 7.5	3, 5.0	1, 7.5	1, 6.0	2, 7.5	2, 10	2, 7.5	1, 6.0	1, 12.5	3, 9.0	3, 9.0
(O)il, (A)sk, (D)ry, (N)it	A	O	O	O	ON	ON	O	O	O	A	O	O	O
(S)elf, (FO), (FA), (FOA)	OA/FA	FA	S/FA	S	FA	FA			OA/FA	S	S	S	S
Emerg. Tsfm; mva	7.5				7.5		None	None	None		18.0	3, 9.0	
(O)il, (A)sk, (D)ry, (N)it	O	D								O	O	O	O
(S)elf, (FO), (FA), (FOA)	OA/FA				FOA					S	S	S	S
Sta. Serv. Tsfm; No. per generator, kva	1, 1000	4000	1, 12500	2, 750				None	1, 10000	2, 500	4, 750	4, 1250	
(O)il, (A)sk, (D)ry, (N)it	A	O	O	D					D	A	ON	D	
(S)elf, (FO), (FA), (FOA)	OA/FA		S/FA	S					FA	S	S	S	
Ltg. Tsfm; No. per generator, kva	7, 15 & 30	12, 25	2, 3	8, 15					2, 250	1, 100	2	1, 300	
Db noise limit for boiler feed pump											90		
Largest motor on LV bus, on HV bus, HP	100/1500	250/1250	200/2250	125/1750			300/2000	300/2000	250/4000	50/2500	200/2500	250/4500	250/4500
Total motor load, HP	3500	5205	11310	11000					23500	4500		70000	
Types OD motor encl (T)ot, (W)P, (S)P		TWS	T		S	S	TW	TW	W		WP	T	T
Usual motor insulation class (A), (B), (H)	A	AB	A	B	B	B	A	A	A	A	A	ABH	ABH
Automatic transf. to Aux. Source (I)md, (D)elayed	I	I	I				I	I		I	D	i°	i°
Power cable in (D)ucl, (T)ray, (P)ipe, on (R)ack	P	P	PT	D	D	D	T	T	DT	D	TP	DP	DP
(C)opper, (A)luminum conductor cables	C	C	C	C	C	C	C	C	CA	C		C	C
Cable voltage (2)400, (4)160v; Type (S)hielded (N)ot shielded; (A)rmored, (U)narmored	2 NU	2 NU	2A NU	2 NU	4 N	4 N	4	U	4 SN	2 N	4	4 N	4 N
Use 600v class MI cables for power	•		•										
No. of generator units served per battery	2	1	1	3	2	6				1	2	2	
Battery supplies emerg (L)ab oil, L(i)ghts, (H)yd seal, (M)otor operated valves	i M	L i M	All	L i	L i H	L i H	L i H	L i H	L i	L	L i H	All	All
Control Instrumentation													
Contr. centr. serves (1) (2) (3) (4) units		1	2	2	2		2	2	2	3	2	2	2
(A)ir-conditioned, (S)oundproofed			AS	AS	AS		AS	AS	AS	A	AS	A	A
No. in shift for mech & elec oper	8	17			2		6	2		3		12	
Instruments grouped functionally	•	•		•	•	•	•	•	•	•	•	•	•
Benchboard for (T)urbine (G)en (A)ux	A		T	TGA	T				G	TGA		TGA	TGA
Vert. board for (R)ecdrs, (I)ndic (A)nnunc	RIA	RIA	RIA	RIA	RIA		RIA	RIA		RA	RIA	RIA	RIA
Miniaturized contr. bd. (w)ith with(o)ut mimic bus			o							o	o	w	w
Mintr. instr. transm. (E)lec (H)yd (P)neum		P	P	P				E	EP	P		EP	EP
Flashing annunc. acr. board top			•	•		•			•			•	•
Contr. cables in (D)uct (P)ipe (R)ack (T)ray	R	DP	T	PT	T	T	T	T	T	T	T	DPRT	DPRT
Control & power cable in same tray							•	•	•		•		
Cable (P)olyeth pvc (M)in. ins. (L)ead sheath (N)on-metal sheath		P	PMLN	P		N			N	P			
Comm. (T)elep, (C)arrier, (M)icrowave	TC	TC	T	TC	T	T	TM	TM	T	TC	TC	TCM	TCM
Sound-powered intercoms		•											
Public address sys. around plant	•	•	•	•	•	•	•	•	•	•	•	•	•
Disturbance starts (A)uto oscillo, speeds up (R)ecorders				A					A			AR	A
(M)ulti-pen (P)rinting oper. recorder	M	MP	MP	MP			MP	MP			MP	MP	MP
Type cable in high temp. locations		AVC	AVA									MI	MI
Outgoing Substations													
Tsfm rating: ___ph ___Mva	3/56	3/58		1/53			3/105	3/120		3/84	3/105	3/150	3/325
Cooling (S)elf, (FO), (FA), (FOA), (FOW)	FOA	FA		S			S	S		FOA	FOA	FOA	FOA
Fire Prot. (W)ater (C)O_2, (M)ats (D)ry							MD	W	M	W		M	M
(S)un (S)train (R)igid; (C)opper, (A)lum., (W)elded	SA	SA		SR			AW	AWW	RA	RC	S	RACW	RACW
Structure (P)ipe, (A)ngles, (C)hannels	AC	AC		A			P	P	P	A	A	WF	WF
Pressure relays, (A)larm, (T)rip	A	A					AT	T		A		T	T
Ltng prot (M)asts, (G)rd mesh	G	MG		G			M	G	M	G	MG	Grd W	Grd W
Ltg arr. on (T)sfmterm, (O)mitted	T	T		Line				O		T	T	T	T
Iron piling retained for sta. ground								•	•		•		
Structures tied to (C)opper, (S)teel grd mesh	C	C		C			C	C	C	C	C	C	C
Cable racks integr with grd mesh										•			
Lighting													
Contr room, (C)ove ltg (L)um ceiling	L	L	L	L	L		L	L	L			L	L
Vert panel (I)nd. ltg (C)ontr lens	I	I							I				
Foot candles, Contr/Turb/Blr		30/20/10			50/-/-		60/60/-	60/60/-	35/12/12			100/50/25	100/50/
Genl sta ltg (I)ncan (F)luor	I	I	I	I		I	F	F	I	I		IF	IF
OD units flood-lighted	•	•	•	•			•	•		•	•		
Lighting voltage (120/208), (277/480)	120/208	120	120/240	120/208	120/208	120/208	120/208	120/208	120/240	120	120/208	120	120
Use MI cable							•	•					

urth Steam Station Check Chart—Design Characteristics Covering



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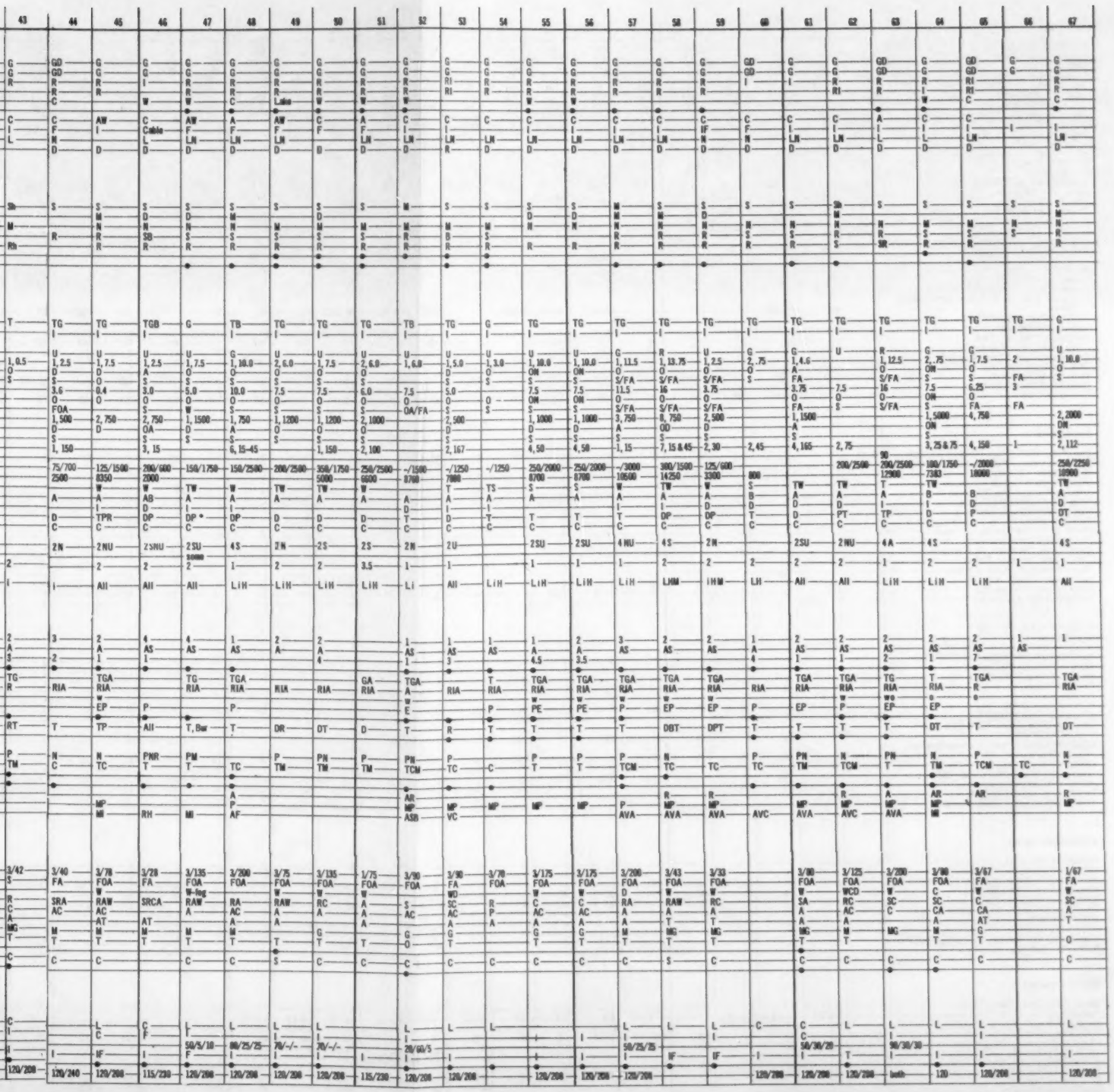

Key to Identification of Plants

No.	Utility	Plant Name
1	Central Maine Power Co	Yarmouth
2	Public Service Co of New Hampshire	Schiller (No. 6)
3	The United Illuminating Co	Bridgeport Harbor
4	New England Power Co	Salem Harbor (No. 3)
5	Conn Light & Power Co	Devon
6	Conn Light & Power Co	Montville
7	Philadelphia Electric Co	Cromby (No. 1)
8	Philadelphia Electric Co	Cromby (No. 2)
9	Philadelphia Electric Co	Schuylkill (No. 1)
10	Rockland Light & Power Co	Lovett (No. 3)
11	West Penn Power Co	Armstrong
12	Public Service Electric & Gas Co (N.J.)	Linden (No. 1 & 2)
13	Public Service Electric & Gas Co (N.J.)	Bergen
14	Long Island Lighting Co	Port Jefferson (No. 3)
15	New York State Electric & Gas Corp	Milliken
16	Consolidated Edison Co of N.Y.	Astoria (No. 3)
17	Niagara Mohawk Power Corp	Huntley (No. 67 & 68)
18	Delaware Power & Light Co (Southern Div)	Indian River
19	Florida Power Corp	Paul L. Bartow
20	Florida Power & Light Co	Lauderdale (No. 4 & 5)
21	Savannah Electric & Power Co	Riverside
22	South Carolina Electric & Gas Co	Silas C. McMeekin
23	Tampa Electric Co	Francis J. Gannon
24	Tampa Electric Co	Hookers Point
25	Virginia Electric & Power Co	Yorktown
26	Carolina Power & Light Co	Louis V. Sutton (No. 1 & 2)
27	The Dayton Power & Light Co	Frank M. Tait
28	Richmond Municipal Electric Lighting & Power Dept	Whitewater Valley
29	Central Illinois Public Service Co	Grand Tower
30	Cleveland Electric Illuminating Co	Avon (No. 8)
31	Cleveland Electric Illuminating Co	Ashtabula (No. 5)
32	Consumers Power Co	J C Weadock (No. 7)
33	Consumers Power Co	B C Cobb (No. 4)
34	Detroit Edison Co	River Rouge (No. 3)
35	Northern Indiana Public Service Co	Dean H. Mitchell
36	Public Service Co of Indiana	New Albany (No. 1 & 2)
37	Toledo Edison Co	Bay Shore
38	Wisconsin Public Service Corp	Weston
39	Illinois Power Co	Vermilion
40	Memphis Light Gas & Water Division	Not Designated
41	Kentucky Utilities Co	E. W. Brown
42	Mississippi Power Co	Gulf Coast
43	City Utilities of Springfield, Mo.	James River
44	Interstate Power Co	Lansing
45	Minnesota Power & Light Co	Clay Boswell
46	Missouri Public Service Co	Ralph Green
47	New Orleans Public Service Inc	Michoud
48	Texas Power & Light Co	Stryker Creek
49	Houston Lighting & Power Co	Smithers Lake
50	Houston Lighting & Power Co	Webster
51	Houston Lighting & Power Co	Deepwater (No. 7)
52	Southwestern Public Service Co	Cunningham
53	Central Power and Light Co	J. L. Bates
54	Central Louisiana Electric Co	Coughlin
55	Arkansas Power & Light Co	Cecil Lynch (No. 3)
56	Arkansas Power & Light Co	Harvey Couch (No. 2)
57	Public Service Co of Oklahoma	Tulsa
58	Public Service Co of Colorado	Cherokee
59	Public Service Co of Colorado	Cameo
60	Southern Colorado Power Co	Canon
61	Southern Nevada Power Co	Clark
62	Utah Power & Light Co	Carbon (No. 2)
63	Los Angeles Dept of Water & Power	Scattergood
64	California Electric Power Co	San Bernardino
65	San Diego Gas & Electric Co	Encina
66	Pacific Power & Light Co	Dave Johnston
67	Pacific Gas & Electric Co	Hunter's Point (No. 4)

Explanatory Notes

Plant No.	Item	Note
4	Gas recirc fans per boiler (No.)	Recirculation from ID fan outlet
4	Heat. grded (R), (X), (D)kn tsf	Ground fault neutralizer
7	Feedwater pumps per boiler	Two BFP with common spare
8	Feedwater pumps per boiler	Three BFP with common spare
9	Feedwater pumps per boiler	Two (Re-entry)
12, 13	Automatic transf to Aux Source	Fast controlled angle
12	Prin fuels	High viscosity bunker C
13	External walls (A)lum, (B)rick, (C)onc-Asb	Concrete panels with Q panels in upper area near roof
14	Unloading (G)antry, (L)oco, (B)oomcrane	Unloading tower
14	HP htrs in (T)urb room (A)bove, (B)elow	Vertical through deck
14	LP htrs in (T)urb room (A)bove, (B)elow	Vertical through deck
16	Feedwater pumps per boiler	One, with two half-sized spares
16	Dust (A)irhtr, (D)ust coll, (F)ans	Four airheaters, two dust collectors and four FD fans
16	No. of generator units served per battery	Three batteries per generator
16	Type cable in high temp locations	Ozone resisting rubber
17	Fan couplings (H)ydr, (E)lec, (M)ech	ID fans have hydraulic couplings FD fans are constant speed with vane control
17	17	Type cable in high temp locations
25	25	Prin fuels
25	25	Fuel delivery (R)ail, (B)arge, (T)ruck (P)ipe, (B)elt
32, 33	32, 33	Hot well compartmentized
34	34	Prin fuel
34	34	Fuel delivery
34	34	Main steam line
34	34	Contr. cable in (D)uct, (P)ipe, (R)ack,
35	35	Stacks (B)rick, (C)oncr, (S)teel
36	36	Stacks (B)rick, (C)oncr, (S)teel
42	42	Comm. (T)elep, (C)arrier, (M)icrowave
46	46	External walls (A)lum, (B)rick, (C)on
47	47	(A)luminum, (C)opper alloy cond tube
47	47	Power cable in (D)uct, (T)ray, (P)ipe,
48	48	Prin fuel

Abbreviations

•	Yes
Asb	Asbestos
Attemp	Attemperator
Belt W	Belt Weightometer
Bd Stm	Bleed Steam
Blr Rm	Boiler Room
Bur	Buried
C Htr	Closed Heater
Conc	Concrete
Cyc	Cyclohexylamine or Cyclones
Gd W	Ground Wire
Harb	Harbor
Man	Manual
Oil B	Oil Base
Recip	Reciprocating Pumps
Reinj	Reinjected
Std	Standard
Stm Dr	Steam Driven
Stm T	Steam Tracing
Stok	Stoker
Vert	Vertical

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Note

Silicone
Delayed petroleum coke
Delayed coke delivered by earthmoving equipment
Storage type hotwell
Blast furnace gas
Self-unloading steamer
Pressed and drawn
Armored
Two stacks per boiler
Space in bottom of stack used for circ water pumps, salt water pumps, and water treatment equipment
Teletype
Galbestos
½ Al-Br, ½ Co-Ni (10%)
Buried
Future lignite and char

Electrical World

Plant Number	1	2	3	4	5	6	7	8	9	10	11
Total initial capability – Mw	88	50	83	140	110	90	165	220	175	66	165
Number of units (init/Ult)	2/6	3/5	1/6	2/–	1/2	1/2	1/2	2/2	4/5	3/4	1/4
Geographical area	NE	NE	NE	NE	NE	NE	MA	MA	MA	MA	MA
Initial operation	12/57	9/57	7/57	8/58	2/56	6/55	7/54	10/55	5/58	55	4/58
Steam pressure	1250	1250	1450	1800	1800	1400	1800	1800	2400	1800	1800
Steam temperature (Supht)	950	950	1000	1000	1000	1000	1000	1000	1050	1050	1000
Steam temperature (Reheat)			1000	1000	1000	1000	1000	1000	1000	1000	1000
Prin fuels – (B)it, (A)nt, (L)ig, (C)har, (G)as, (O)il	OB	OB	BO	BOG	B	B	BO	BO	O	BGO	B
Boilers per turbine	1	1	1	1	1	1	1	1	1	1	1
Bunkers per boiler	2 Silos	1	3	1	1	1	1	1		1	1
Pulverizers per boiler	2	2	3 Cyc	4	4	4	4	8		4	2
Feedwater pumps per boiler	2	2	2	3	3	3	2•	3•	2	2	3
FD/ID fans per boiler	1/1	1/1	2/0	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2
Extraction points	5	5	6	6	6	6	6	6	6	6	6
Hydrogen cooling pressure, psi	30	0.5–30	0.5–30	0.5–30	45	0.5–30	0.5–30	0.5–30	0.5–30	0.5–25	
Operators per shift per Mw		.115					.03	.03			
Generator – kv	13.8	13.8	13.8	14.4	13.8	13.8	20	20	13.8	13.8	18
Mn power transf per unit	1	1	1	3–1 ph	1	1	2	2	2		1
General Features											
No. of operating levels	2	1	1	3	1	2	12	12	12	2	4
Layout (C)onventional, (H)orizontal	C	C	H	C	C	C	C	C	C	C	H
Equipment outdoors (B)lr, (T)urb, (F)ans, (P)umps, (A)irpritr, (D)ust Coll, (C)irc water pumps, traveling (S)creens		S	ABDS	D	D	D	BFADS	BFADS	F3D		BFAD
Turbine on (O)pen deck with (G)antry	G										
Ventilated cool-preg. room		•	•				•	•			
Dust (A)chtr, (D)ust coll, (F)ans			F	AF	AF	AF	ADF	ADF		F	ADF
(G)rating floors, (F)orced air vent.		G	G	GF	GF	GF	GF	GF	GF	GF	G
External walls (A)lum, (B)rick, (C)onc-Ash.	B	BC	C	BC	A	A	A, Tile	A, Tile	AB	B	AB
Design for (Q)uick load pickup		Q	Q						Q		Q
Crane, tons and No. of hooks	60, 15/2	80	50/2	150, 20/2	150/2	125/2	75/2	75/2	50/2	100, 15	75/2
Stacks (B)rick (C)oncr. (S)teel	S	S	C	B	C	S	C	C	S	S	C
Stack height in feet	76	150	200	250	340	250	300	300	275	175	230
Fuel and Handling											
Fuel Delivery (R)ail, (B)arge, (T)ruck, (P)ipe, B(e)lt	B	B	R	e	B	B	R	R	BP	RP	RT
(R)otary car dumper, car(V)ibrator, (Q)uick unloading car			V				R	R		V	R
Hoppers accom. 1, 2, 3 cars simul.			2				1	1		1	1
Single Conveyor to stockpile or bunkers		•	•		•	•	•	•		•	•
Unloading (G)antry, (L)oco, (B)oomcrane		G		G			B	B		L	
Piling (L)oco, (G)antry, (E)athmoving		E	E	G	E	E	E	E		E	E
Recl'm'g (L)oco, (D)rag (E)arth-moving		E	E		E	E	E	E		E	E
Tramp-iron separator P(u)lley or P(l)ate magnet			I	u		u	u	u		u	u
Pile treated for (W)ind-blow; (S)ealed tripper			W	W			W	W		S	S
Coal Sampled (C)ontin. (I)ntermittent		I	I	I	C	C	C	C		I	C
Weight: (S)cale, (F)low-meter, Str. (G)auge			S	SF	S	S	G	G		S	S
Fuel Conveyp. (I)ntegrated (T)allied		T	I	T			I	I		I	I
Pulverizer type B(a)ll, B(o)wl, (A)ttrition		a	Cyc	a	a	a	a	a		a	a
Bunker chutes (S)traight, (V)ibrated		S	S	V	SV	SV	S	S		V	S
Bunker capacity – ? hrs operation		36	53	50	60	60	36-48	36-48		50	36
Small bunkers with ready coal pile											
Steam generator											
Boiler (O)utdoor, (S)emi-outdoor			S				S	S			S
Burner area (I)ndoors, (O)utdoors	I	I	I	I	I	I	I	I	I	I	I
Furnace: (C)yclone, (T)ang, (T)urbo			C					T	T		T
Pressurized furnace, in.			10				20				
No. of drums	1	2	1	1	1	1	1	5	1	1	1
No. of burners per boilers	6	6	3	16	16	16	8	32	24	16	12
Burners (H)or, (V)ert, (T)angential	H	H	H	H	T	T	H	T	T	T	H
Suphtr. contr (D)amp, (B)urner (S)pray (G)as recirc (C)ond's't (T)win furn.	S	C	SG	S	BS	BS	SG	SB	BSG	BS	S
Reheat contr (D)amp, (B)urner tilt, (S)pray (G)as recirc (C)ond's't (T)win furn.			SG	SG	BS	BS	SG	SB	BSG	BS	DS
Circulation (N)atural (F)orced	N	N	N	N	N	N	N	F	F	N	N
Welded platens for tubes, (W)alls (S)upt (R)tr			WSR	W			WSR	WSR	SR		S
Pendant for (S)uperhtr (R)eheater		S	SR	SR					SR	SR	S
Torch for burner ignition (G)as, (O)il	O	O	O	O	O	O	O	O	O	GO	O
TV for (G)auge, (B)urners, (S)tack, (C)onveyors					B	B	G	GB	G	GB	
Ash Control and Disposal											
Furnace(D)ry, (W)et bottom	D	D	W	D	D	D	D	D	D	W	D
Soot-blower (R)etract (L)ance (M)anual	R	R	R	R	R	R	R	R	R	R	R
Soot-blowers (A)ir, (S)team (A)uto seq.	S	S	SA	AA	AA	AA	SA	A	S	A	SA
(M)ech & (E)lec or (E)lec & (M)ech coll'rs	ME		EM	E	ME	E	ME	ME	M	M	E
Collectors outdoors (M)ech (E)lec	E		E	E	ME	E	ME	ME	M		E
Precipitator rectifiers (R)otary (E)lectronic	R		E	E	E	R	R	R			E
Bottom ash sluiced	•		•	•		•	•	•		•	•
Flyash (S)old, (D)umped	D	D	D	D			D	D	D	D	SD
Flyash sold (B)ulk, (P)ackaged for (C)ement, (A)sph. filler											BPC
Additives to ease fouling											
Heat Cycle Apparatus											
Makeup (E)vap, (Z)eol, (D)emin, (T)reated	D	D	D	ET	D	E	D	D	D	E	D
Feed water pH		9.0–10.5	8.5–9.0	10.5–10.8			10.0	10.0	10.0	8.8–9.2	
Economizer pH		9.0	9.0	8.7–8.9			8.9	8.9	8.9		
Final FW temp at capability	436	425	459	467	510	500	470	470	525	535	465
FW htrs group by-passed (H)P, (L)P, (N)ot	H	HL	HL	L	H	H	HL	N		H	HL
Two strings of HP heaters								•			
HP heaters in (T)urb room (A)bove, (B)elow		T	TB		TA		TA	TA	A	A	B
LP heaters in (T)urb room (A)bove, (B)elow	TB	T	TB	TV	TA		TB	TB	AB	TB	B
Air htr (R)agon, (O)D, (S)plit for ntco	R	R	R	R	R	R	S	R		S	RS
Steam for reheat (T)empers heater air					T		T	BdStm	T		T
Press'z'd hot-air ducts (W)elded	W	W	W				W	W		W	W
Feed pump handles (H)ot, (C)old water	H	H	H	H	H	H	H	H	H	H	C
(H)ydrazine, (M)orpholine used		HM	Cyc	M	H	H	M	M	M	H	

orld's Fourth Steam Station Check Chart—Des

10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
	165 1/4 MA 4/58 1800 1000 1000 B 1 1 2 3 2/2 6 18 1	450 2/6 MA 2/57 2350 1100 1050 O* 3 & 1 4 2/0 6,8 15-45 .026 18 2	550 2/- MA 58 2350 1100 1050 B 1 6 Silos 3 3 2/0 8 15-45 18 1	156 1/2 MA 10/58 1800 1000 1000 B 1 5 5 4 3 2/2 6 0.5-30 .025 20 1	152 1/4-6 MA 9/55 1850 1000 1000 B 1 2 4 3 2/2 30-45 .04 13.8 2	335 3/6 MA 5/58 2000 1050 1000 BOG 1 1 8 1* 4/0 7 30-45 20 2	400 2/- MA 57 2400 1050 1000 B 1 1 6 2 2/2 7 13.8 1	80 1/4 SA 57 1800 1000 1000 BO 1 1 3 2 2/2 6 30 14.4 1	120 1/4 SA 58 1800 1000 1000 OG 1 4 (Fut) 4 (Fut) 3 2/2 6 0.5-30 15.5 2	160 3/6 SA 57 1465 1000 1000 O 1 3 2/2 6 30-60 18 1	40 SA 56 1250 950 GO 1 2 1/0 5 30 .05 13.8 1	275 2/4 SA 4/58 2400 1050 1000 B 1 1 4 3 2/2 7 15-30 .033 13.8 1	130 1/6 SA 7/57 1450 1000 1000 B 1 1 3 4/0 5 0.5-30 .054 15.5 2	75 1/1 SA 5/55 1250 950 O 1 3 2/0 5 0.5-30 .04 13.8 1	175 1/4 SA 6/57 1800 1000 1000 BC*G 1 1 4 2 2/2 7 30-45 .028 22 2	200 2/6 SA 8/54 1450 1000 1000 B 1 4 silos 4 3 2/2 5 0.5-30 .018 13.8 3-1 ph	150 1/2 ENC 10/57 2400 1050 1000 B 1 1 4 2 2/2 30 .02 16 1	33 1/4 ENC 3/54 860 900 BO 1 3 3 2 1/1 5 0.5-30 14.4 1	100 1/1 ENC 9/57 1450 1000 1000 B 1 1 4 2 2/2 5 0.5-30 .06 13.8 1	250 1/- ENC 12/58 3500 1100 1050 B 1 1 8 3 2/2 8 45-60 .012 22 1
	4 H	2 H	2 H	1 H	2 C	1 C	2 H	2 C	1 C	1 C	1 C	2 C	2 C	2 C	2 H	3 C	5 C	6 C	1 C	3 H
	BFADS	BFACS	BFADCS	All TG	FD	D		FS	FDCS	All OG	BFACS	FADC	BAFDCS	FACS	All	All OG	BFADS OG			D
	ADF G AB Q 75/2 C 230	AF GF B 200/2 S 225	AF GF * 125/2 B 305	ADF GF BC Fut 55, 15/1	ADF GF AB 150 B 250	* GF B 200/2 S 300	• GF A 100/2 C 350	ADF G C Q 125/2 C 230	ADF G B 100/2 C 250	ADF G 40, 10/2 C 150	 C 30/2 S 190	ADF BC 150, 30/2 C 300	ADF GF C 150, 15/1 S 197	GF C 60, 10/1 S 180	AF GF C 60/2 C 325	ADF G 50, 10/2 BC 200	ADF F AB Q 75/2 S 225	G B Q 30/2 S 15	A G B 75/2 S 250	AF G AB 175/1 C 400
	RT R 1 • E E u S C S I a S 36	P	R R • E E u I S I a SV 4	B • • E E u WS Fut G T o SV 40	R • 1 • E E u W C S T o SV 14	B • B E E u WS C S I o S 24	RB R • E E u C SF T o S 32	R V 1 • LB E E I C S I A S 48	BP	B	BP	R V 2 • L E E u C SG IT o S 14	B	Ship	RP* V 1 • E E u S I S IT o V 48	R V 1 • L E E u S C Belt W I A Silos 27-30	R R 3 • L E E u W C S I A S 26	R V 1 • L E E u W C S I A S 60	R V 1 • L E E u W C S I A V 30	RT R 2 • G GE L I W C S T o S 33
	S I T 1 12 H S OS N S S O	S I T 18 1 12, 24 H SG T N WSR SR G B	O O T 18 2 24 H C T N WSR SR O B	S 1 20 T S B N WSR SR O G, B-Fut	 I 1 16 T S BS N SR S O 	I T 13 1 32 H GS TS N SR G GS	I T 1 24 T TS TS F W SR O B	I 1 9 H SG SG N SR O 	I 1 16 H DG DG N WSR SR O B	O 1 16 H SG SG N SR O 	O Semi O 1 8 T BS N S S G 	S I T 1 16 T S BS F SR SR O GB	S I C 1 3 H SG SG N SR O 	I 10.5 2 12 T BS N S 	O O T 1 32 T S BS F W SR O GB	O O 1 16 H G, Attemp D N S O 	S I 1 None 16 T S B F SR G B	I 2 6 H D N S O 	I T 1 None 8 T S BS WSR SR 	I T 1 None 8 T S BS WSR SR
	D R SA E E E • SD BPCA	W P AA • 	W R AA ME ME E • S BCA	D R A • D 	D R A • D 	D R SA ME ME • D 	D R A ME E • S B	D R SA ME E E • D 	D R SA M M • 	D R SA 	D R S 	D R A M M • D 	W R SA E E E • Rainj 	R SA 	D R AA M M • D 	D RL AA M M • D 	D R AA ME ME R • D 	W R SA M • D 	D R SA • 	D R AA E E D
9.2	D 466 HL B B RS T W C	DT 6.5-9.5 527 HL T RO T W H H	D 6.5-9.5 515 HL T RO T W H H	E 8.0-9.0 8.0-9.0 460 N T* T* R W H H	D 8.0-9.0 8.0-9.0 475 N TB TB RS W H H	EZ 7-11 493 L Blr Rm B R T W H	D 520 L A R W M	DT 7.0-8.5 8.0 490 N TA TA RS W H M	E 451 N TAB TB ROS W C 	DT 8.5-8.8 478 L T B R W H 	ET 11.0 8.5 516 N A TAB R W H 	D 8.0-9.0 8.0 516 HL TAB TAB R W H M	D 486 N B ROS W N Cyc	E 8.9 8.9 420 T RS W H Cyc	D 8.5-9.0 9.5 475 H TA B ROS W H M	EZ 5.0-8.7 8.7 455 HL T T R W H M	E 9.0 9.0 460 L A B R T W H 	D 9.0 400 H A B R T W H 	D B B R T W H 	D 7.2-7.5 7.5 375 HL B B R W H H	D 9.0-8.5 560 H B B R W H

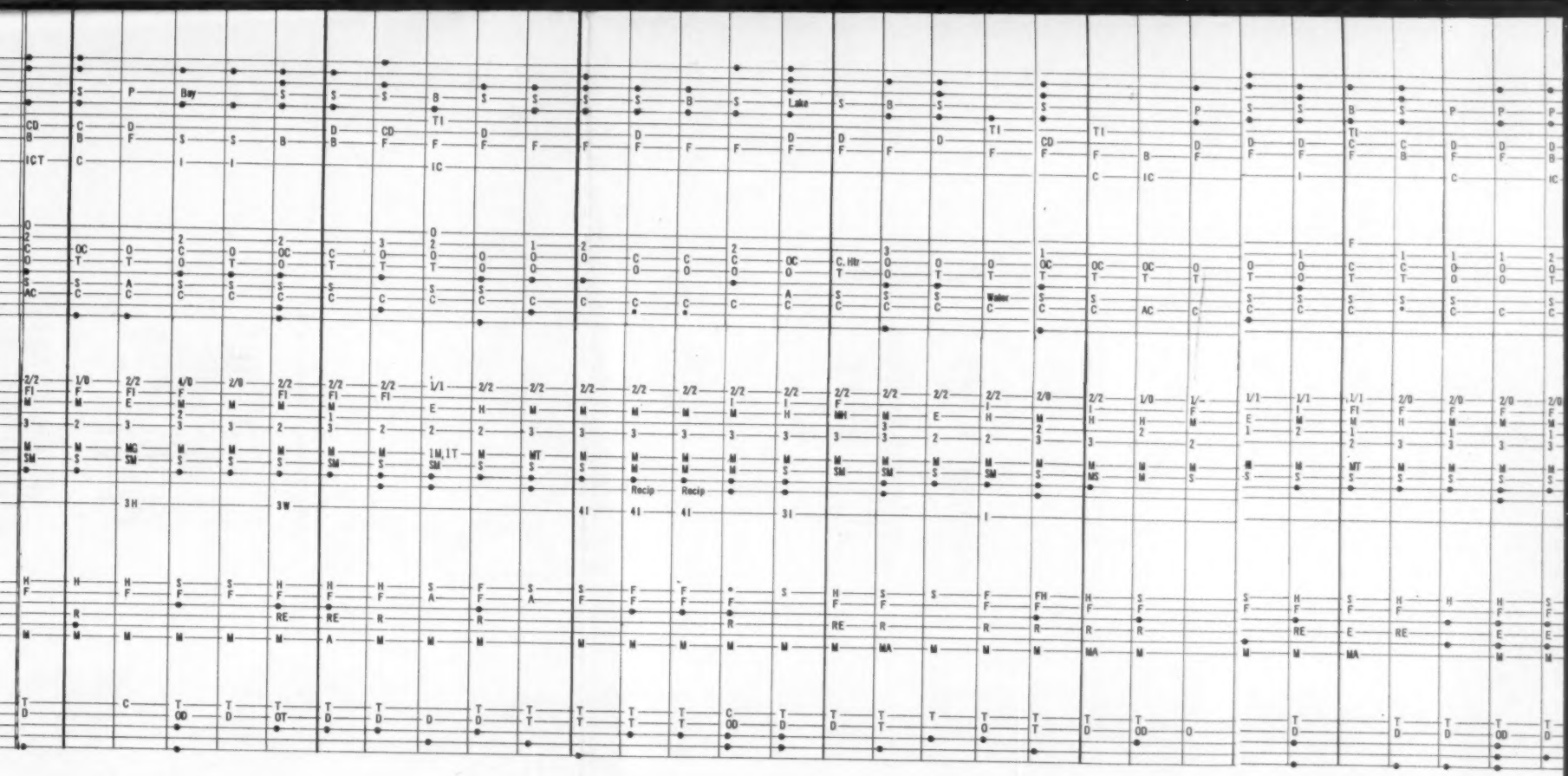
sign Characteristics Covering 67 New Power Pl

31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
225	156	156	300	138	300	135	60	175	862	100	75	44	33	65	20	102	125	350	230	175	75
1/-	1/2	1/-	3/6	1/6	2/-	1/6	1/-	2/-	3/6	1/4	1/4	2/4	2/4	1/4	1/4	1/4–6	1/4	2/6	2/6	7/7	1/-
ENC	ENC	ENC	ENC	ENC	ENC	ENC	ENC	ENC	ESC	ESC	ESC	WNC	WNC	WNC	WNC	WSC	WSC	WSC	WSC	WSC	WSC
12/SH	4/55	8/56	2/56	11/56	3/58	8/55	11/54	5/55	58	3/57	6/57	3/57	9/57	4/58	10/54	57	3/58	58	6/54	55	6/57
2400	2000	2000	2400	1800	1850	2000	950	1450	2400	1450	1000	850	850	1450	850	1450	1800	1800	1450	1800	1250
1050	1050	1050	1050	1000	1005	1050	900	1000	1050	1000	1000	900	900	1000	900	1000	1000	1000	1000	1000	950
1050	1000	1000	1000	1000	1005	1000		1000	1000	1000	1000			1000			1000	1000		1000	
B	B	B	BG * O	BG	B	B	B	B	BG	B	G	BG	B	B	BG	GO	GO *	GO	GO	GO	G
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	3	4	1	1	7	4		2	2	4	1						
8	4	4	6	4	3	4	4	4	7 Cyc	4		1	2	4	2						
3	3	3	3	3	3	3	2	2	3	3	2	2	2	2	2	3	3	3	3	3	2
2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/0	2/2	1/0	1/0	1/1	2/1	1/1	2/0	2/0	2/0	2/0	2/0	2/0
7	7	7	7	6	7	8	3	6	8	5	5		4	5		6	6	6	5	6	
30-45	0.5–30	0.5–30	30	0.5–30	45–60	0.5–30	0.5–30	15–30	45–60	0.5–30	0.5–30	15–45	0.5–15	0.5–30	0.5–30	0.5–30	0.5–30	0.5–30	0.5–30	0.5–30	0.5–30
.013	.032	.032				.07	.004	.05	.02	.04			.031	.046		.029		.011	.017		.04
18	18	18	18		18	18	13.8	13.8	24	13.8	13.8	13.2	13.8	14.4	13.2	13.8	13.8	20	14.4	20	13.8
1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	3-1 ph	1	3-1 ph	1
2	9	9	1	5	1	1	2	2	8	2	2	1	1	2	2	1		2	2	2	3
H	C	C	C	C	C	H	C	H	C	C	C	C	C	H	C		C				C
D			FDS	F	A	AD		FD	ADCS	PDFC	S	BFDCS	CS	BTFAD	BDFCA	All	All	BTFPA	All	BFAS	B
														OG	G	OG	OG	OG	OG		
AF	F	F	ADF	F			ADF	DF	ADF	ADF	A	AD					AF	AF	AF	AF	
G	G	G	GF	GF	GF	GF	G	G	GF	GF	G	F	G	G	G						F
AB	B	B	A	AB	Metal	A	A	AB		B	C	B	B		•	A				B	A
				Q		Q	Q		Q												Q
150/2	200/2	200/2	110/2	150/2	150/2	250/2	150/2	150/2	125/2	60/1	175, 25	75/2	2/1	35/2	50/2	50/3	50/1	55	45, 15/1	75/1	50/2
C	S	S	C	S *	C *	B	S	B	C	S	S	C	C	C	S	S	S	S	S	S	S
400	250	250	425	165	550	225	185	275	400	240		200		250	150	164		168	120	166	80
RT			R •	R	B	RB	R	R	B	R	P	R	B	R	RP	P	PT	PRT	P	PB	P
R			QV	V		R	V	V		V		V		V	Y						
2			4	5	1	2	2	1		2		1		1	1						
•	•	•	•	•		•	•	•	•	•		•		•	•						
G	G	G	B	L	B	L		L	B	L		L		L							
GE	GE	E	E	E	E	E	E	E	E	E		E	E	E	E						
L	E	E	E	E	E	E	E	E	E	E		E	E	E	E						
I	u	u	I					u	I	I		I	u	I	u, I						
W	S	S			WS	S		S		S		W		S							
C	I	I	C	C	C	C	I	C	C	I		C	I	C	I						
S	S	S	F	S	S	S	S	F	S	G	F	F	S	S	S						
T	T	T	I	I	I	I	T		IT	I			I	T	I						I
0	0	0	a, 0	0	Tube	0	0	0	Cyc	a		a	A	A	a						
S	S	S	S	SV	SV	S	S	S	S	V		S	0	SV	S						
30	36	36	24	36	32	36	30	24	48	30				32	36						
			S					S	S			O		O	S	O	O	O	O	O	O
1	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	O	O	O	O	O	O
T	T	T	T	T			Tu		C	T											
				.15					17		12					7.4	•		11	9	18
1	1	1	2		1	1	2	1	1	1	1	2	2	1	2	1	2	1	1	1	2
8	16	16	24	32	18	12	8	16	7 Cyc	16	8	4	6	8	4	12	18	20	18	24	4
T	T	T	H	T	H	V	H	T	H	H	T	T	H	H	H	H	H	H	H	H	T
BST	BS	BS	C	BS	C	DG	S	BS	DSG	ST	DBS	S	C	DS	G	D	SG	D	D	D	BS
BST	BS	BS	T	BS	D	DG		BS	DSG	ST	DBS			DS			SG	D		D	
F	F	F	N	F	N	N	N	F	N	N	N	F	N		N	N	N	N	N	N	N
WSR	W	W		W	WSR						WSR										W
SR	SR	SR	SR	SR	S		S	SR		SR	SR		S	SR		S		S		SR	S
O	O	O	G	G	O	O	O	O	GO	O	G	G	O	O	G		G	G	G	G	G
G				GS	G	G	GB		B	G						B		G		G	GB
D	D	D	D	D	W	D	D	D	W	D	D	W	W	D	DW						
R	R	R	R	R	A	A		R	R	R		R	RM	RL	R						
SA	AA	AA	AA	A	ME	ME	S	AA	AA	AA		A	S	AA	S						
E	M	M	ME	M		ME		M	E	M				M							
			ME		E	ME		M	E			M		M	M						
1/2 E			E						E												
D	D	D	SD	D	D			D		D		D	D	D							
			B																		
	D	D	D	D	D	D	D	D	D	D	ET	D	D	EZ	E	ZE	E	D	D	E	EZT
8.0–9.2	8.0–9.0	8.0–9.0	9.0	9.5–10		8.0–9.1	11.0	8.9	8	8.5			9	6.0–7.2	1.0–8.0	8.75		6.9	6.9	6.9	1.0–8.5
	8.0–9.0	8.0–9.0	9.0	9.0			7.0	8.9		8.5	8.5					8.75					
60	480	480	475	445	464	490	410	541	567	448	460		350	443	335	445	470	460	385	460	425
	N	N	H	HL	N	HL	HL	N	H	N						H	N	N	N	N	H
			•				•														
TB	B	B	A	A		A	B	A		A	TB		A	A	B	T	A	A	T	B	B
B	B	B	TB	T	T	B	B	T	TB	B	TB		B	AB	B	T	B	B	B	T	D
			R	RS	R	O	R		R	R	R		R	R	O	R	R	R	O	R	R
			T																		
	W	W	W	W	W	W	W	W	W	W	W		W	W	W	W		W	W	W	W
	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
	M	M		M						M					H	M					M

Plants in the United States

	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67
	75 1/- WSC 6/57 1250 950	66 1/2 WSC 4/58 850 900	56 WSC 4/58 1450 1005 1005	135 1/- WSC 6/54 1450 1000	135 2/- WSC 6/54 1450 1000	103 WSC 9/56 2000 1000 1000	100 1/6 Mtn 7/57 1450 1000 1000	22 1/6 Mtn 7/57 850 900	18 1/2 Mtn 9/55 850 900	119 2/2 Mtn 5/57 1800 1000 1000	100 1/2 Mtn 7/57 1450 1000 1000	156 2/4 Pac 10/58 1850 1000 1000	60 1/4 Pac 6/57 1850 1000 1000	100 2/4 Pac 10/54 1450 1000 1000	100 1/4 Pac 10/58 1450 1000 1000	165 4/- Pac 4/58 1800 1000 1000
	G 1	GO 1	GO 1	GO 1	GO 1	GO 1	L6 1 4 4	D 1 2 2	B 1 2	GO 1	BO 1 1 4	GO 1 Fut	GO 1	GO 1	GOB 1 6 6	GO 1
	2 2/0	2 2/0 4	2 1/0	3 2/0 5	3 2/0 5	3 2/0 5	3 2/2 8	3 1/1 4	2 1/1	2 1/0 6	2 2/2 5	3 2/2 6	2 2/0 5	3 2/2 5	2 2/2	3 2/2 7
	0.5-30 .04 13.8 1	0.5-30 .045 13.8 1	0.5-30 13.8 1	15-30 .033 1	15-30 .026 1	30-60 .02 14.4 1	15-30 .0416 15.5 3-1 ph	0.5-15 .0182 13.8 1	0.5-30 .25 14.4 1	0.5-30 .04 13.8 1	0.5-30 13.8 1	0.5-30 .025 18 1	30 .033 13.8 1	0.5-30 .033 13.8 1	30 13.8 1	0.5-30 18 3
	3 C	3 C	1 H	2 H	2 H	2 C	2 C	2 C	2 C	2 H	2 C	1	2	2 C	C	1 H
	B	BFA	All OG	BTFC OG	BTFC OG	BTPAC OG	BFADC G	BFADC G		BFAC G	BFADC	FPDCS	BTFAC OG	CS	All	BTFA O
		F		F	F	F			F		AF	ADF	F	AF	F	AF
	F				G		GF	GF	F		GF	GF		GF		GF
	A Q	B Q		ABC	ABC	A	Aza	A	C	B	Steel	ABC Q		Conc Q	A	C
	50/2 S	75/10 S	25/1 S	50, 10/1 S	50, 10/1 S	40/1 S	200/2 C	40/1 S	20/1 S	30/1 S	25/2 S	125/2 C	35/2 S	175/2 S	C	75/2 S
	80	72		147	147		300	150	150	100	200		120		250	250
	P	P	P	P	P	P	R V 2	B	T 1	PT	R V 1	T	RT	P, Ship	R 1	B
							L E E a	E E I	D I		L E E a				E E	
							I S I A S	I S I a	I F I Stok S	F I	I S I a V	SFG I	I	I	W I F I	
							28	28	24		43				23	
	0 0	0 I	0 0	0 I	0 I	0 0	S I	S I	I I		0 0 C	S I T	0 0	I	0 I Tu	S I
	18 2 4 T	25 2 18 H	20 1 18 H	1.5 1 18 H	1.5 1 18 H	10 1 15 H	1 12 V	2 4 H	2	10 1 6 H	1 24 T	2 16 H	25.0 1 20 T	2 10 H	6 H	1 15 H
	BS	S	DS	DG	DG	S	SG	Atlasmp	S	S	BSG	DSG	S	OBSG	S	SG
	N W S G GB	N	D N	N	N	S N SR SR G G	SG N SR S G G	N S O	N S	DS N SR G	BSG N SR O GB	DSG N R S G GB	BS N WSR SR GO B	OBG N SR S G GB	S N O G	SG N SR G GB
							D R AA M	D M S M	Stok R S M		D R SA M M	D R SA M M		R SA	D R A M M	R SA
							D		D		D				D	
	EZT 1.0-8.5	D	D 8.5	E	E	D 9.0	E	E	E	EZ 9.0 9.0	EZ 8.7-8.8 9.0	EZ 8.7 8.7	D 9.4 9.4	ET 8.5-9.0	E	E 8.0-8.5
	429 H	365 HL	460 H	450 N	450 N	N	505 H		360 N	486 N	462 H	522 N	446 HL	458		466 N
	B B R	T T O	A T R	B O	B O	A B	A T O T	A T O T	A T O	T T R	B B R	AD B R	B B R	TB TB R		B B R
	W H	W H	W H	W H	W H	W H	H	H	W H	W H	W	W H	W C	W H		W H

Condensing, Cooling Water																					
Screen well at plant wall		•		•						•											
Circ. pump at screen well	•	•	•	•		•			•	•		•	•	•		•	•	•	•	•	
Diff. head actuates screen												•	•				•				
Recirc. to (S)tream, (B)asin, (P)ond		S	Harb.	Ocean			S	S	S				S			S	S	B	S		
Chlorinated for slime control			•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
Cooling (T)ower, (I)nduced, (F)orced draft			TI																		
Wells for (C)ooling, (D)rinking	CD	D				CD					CD			C				D		CD	
Cooling water (F)resh, (S)alt, (B)rackish	S	S	S	S	S	S	F	F	F	B	F	S	B	S	F	S	F	B	S	B	
Corrosion protection at (I)ntake, in (C)ondenser, insulated (T)ube sheets			C	C				IC						IC				IC	IC	ICT	
Condenser																					
Cond. (O)D, serves as Turb (F)oundation										F											
Heaters in throat (No.)	1		1	2	1	1				1	1		3				2		2	2	
Deaeration in (O)pen FW htr, (C)ond.		D	O	OC	C	C	C	C	C	O	O	OC	C	C	O	O	O	OC	O	C	
Divided water-box (T)wo-pass (O)ne-pass	T	T	O	O	T	T	O	O	T	O	T	O	O	O	O	O	O	O	O	O	
Sel low for siphon oper	•	•	•	•			•	•	•			•		•		•	•	•	•	•	
Hogging Jet (S)team, (A)ir	S	S	S	S			Pump	S	S	S	S			S	A	S	A	S	S	S	
(A)luminum, (C)opper alloy cond. tubes	A	C	C	A	A	A	C	C	C	C	C	C	C	A	C	C		AC	C	AC	
Hot well compartmented			•					•													
Reverse flow cleaning	•	•	•		•	•					•				•						
Fans and Pumps																					
FD/ID fans per boiler (No. ea.)	1/1	1/1	2/0	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/0	2/0	2/2	2/2	4/0	2/2	2/2	2/2	2/2	
Outdoor Inc. (F)D, (I)D fans				I		I	FI	FI	I		FI	F	F	FI	I			I	I	FI	
Fan couplings (H)yd, (E)lec, (M)ech	M	E	M	M			M	M	M	H	M	H	H	M	M	M	•	M	M	M	
Gas recirc fans per boiler (No.)			1	•			2	2	2			2				4					
Feed pumps per boiler (No.)	2	2	2	3	3	3	2-1 Sp	3-1 Sp	2 •	2	3	4,3	3	3	2 1/2	1	2	2	3	3	
Feed pump drive (M)otor, (T)urb, (G)ear, Main turbine (S)haft	M	M	M	M	M	M	M	M	M	M	M	MG	MGS	M	M	MS	T	M	M	M	
Turbine oil pump drive (S)haft (M)otor	SM	S	S	S	M	M	S	S	S	S	S	SM	SM	M	S	MS	MS	S	SM	SM	
Vertical condensate pumps	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
Pos Displ rotary vac. pump					•	•	•					•	•								
Pumps for forced circ (No.), (I)njection seals, (W)et or (H)ermetically sealed motor drive								3 I, 1 W	W												
Piping and Valves																					
Main steam line (F)orged & bored, (H)ollow forging, (S)eamless, (W)elded seam, (C)entrifugally-cast	S	S	H	H	S	F	F	F	H	S		H	H	H	FS	H	F	H	H	H	
Main stm (F)erritic, (A)ustenitic	F	F	F	F	F	F	F	F	F		F	F, A	A	F	F	F	F	F	F	F	
Valve betw suprhtr & turb stop omitted				•			•	•				•	•	•		•			•		
Freeze up averted by (R)outing (E)lec ht		Stm T		R			E	E	RE	R	RE	RE		R		R					
Cath. prot. for buried pipe							•	•	•			•	•								
Insul of HT pipe (M)ineral, (A)lum shell	M	M	M	M	M	M	M	M	M	M		MA	MA	A	M	M	M	M	MA	M	
Turbine																					
(T)andem, (C)ross-comp	T	T	T	T	T	T	T	T	T	T	T	T	C	T	T	C	C	T	T	T	
Flow (O)pposed, (D)ouble, (T)riple	D	D	D	Y	D	D	T	T	D	D	OD	T	D	T	T	D		OD	OD	D	
Valve chest at middle			•	•	•	•			•		•			•					•		
Quick start provisions		•	•					•	•		•			Fut				•	•		
Therm prot against motoring		•					•	•	•			•	•	•		•				•	

Continued on Reverse Side

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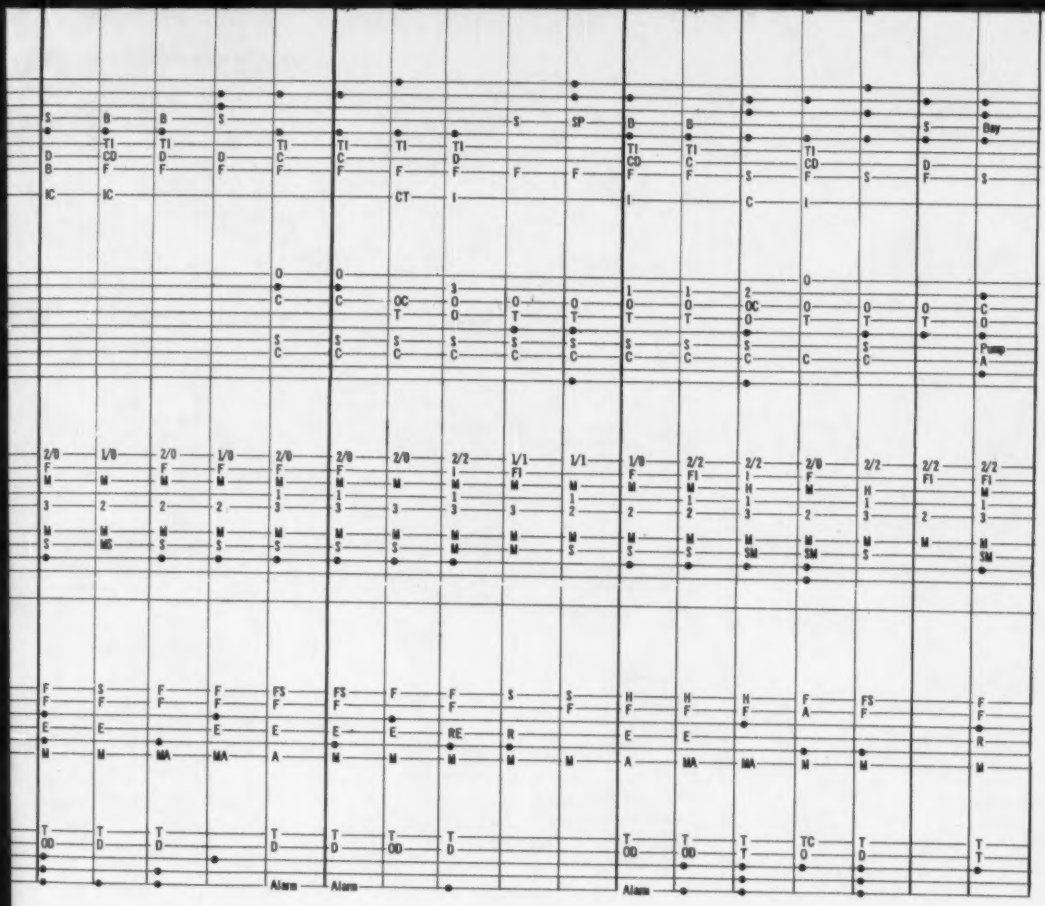
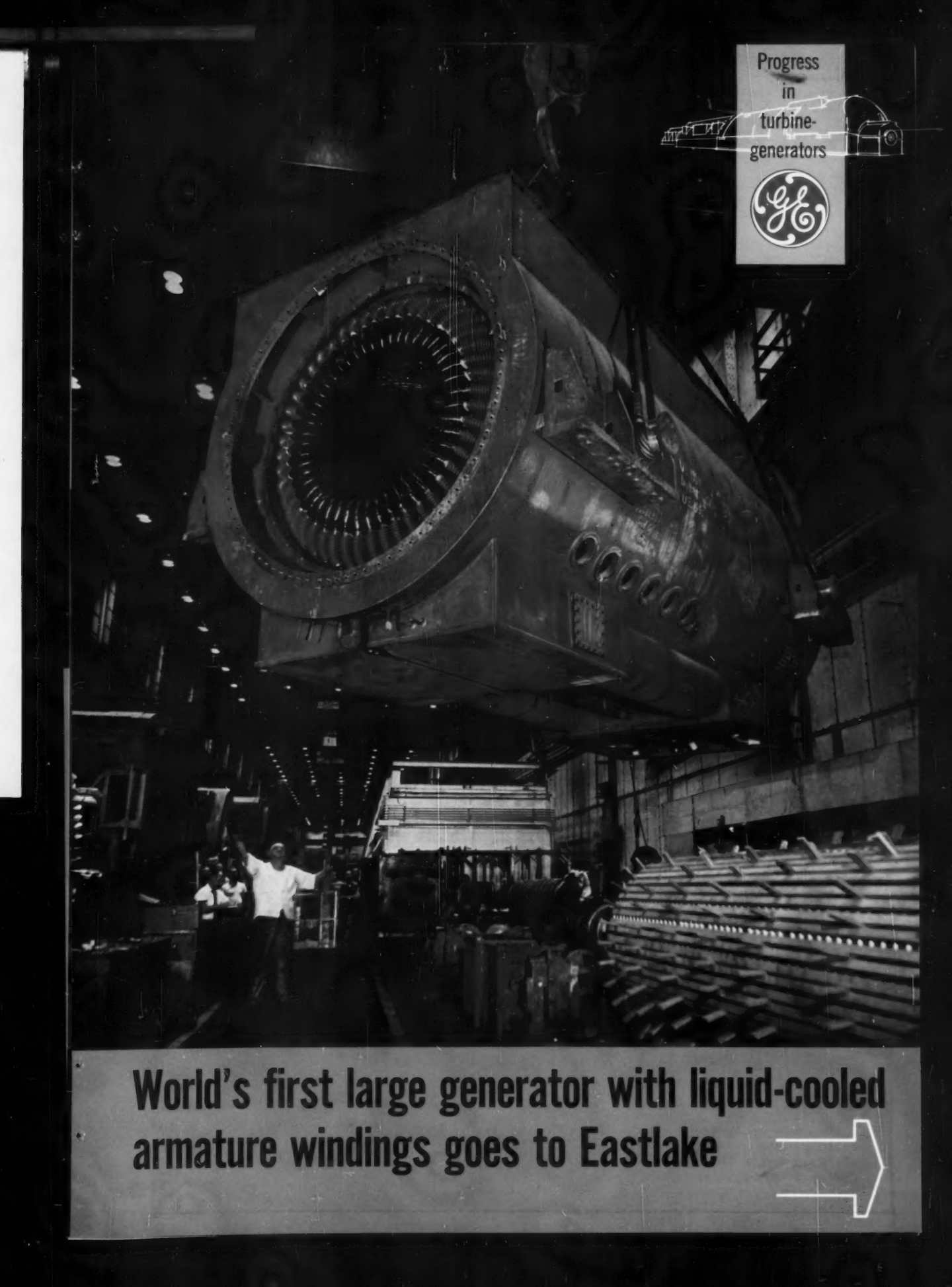

Key to Abbreviations and Identity of Plants on Reverse Side



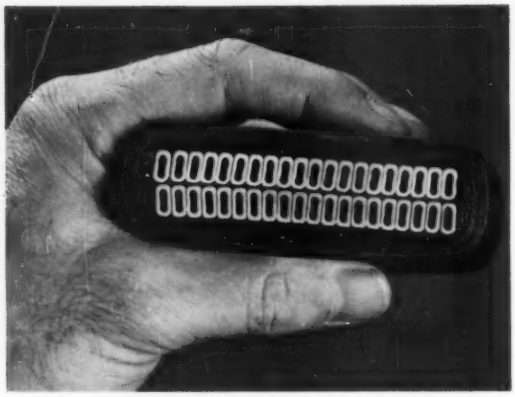
World's first large generator with liquid-cooled armature windings goes to Eastlake

New General Electric cooling system

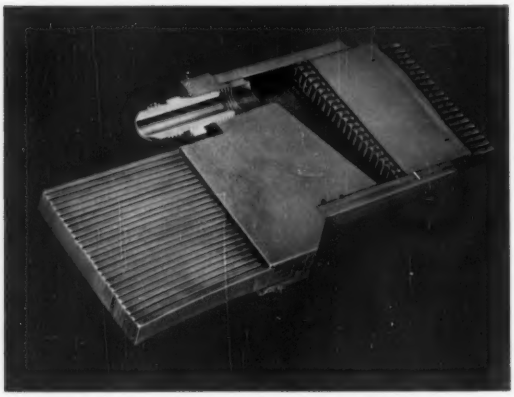
...without appreciable

This evolutionary new 260,000-kva generator incorporates one of the most significant advances in generator cooling since General Electric pioneered hydrogen cooling in 1937. Now in operation at the Cleveland Electric Illuminating Company's Eastlake Plant, it is the world's first large generator with liquid-cooled armature windings. The liquid circulates right through the conductors.

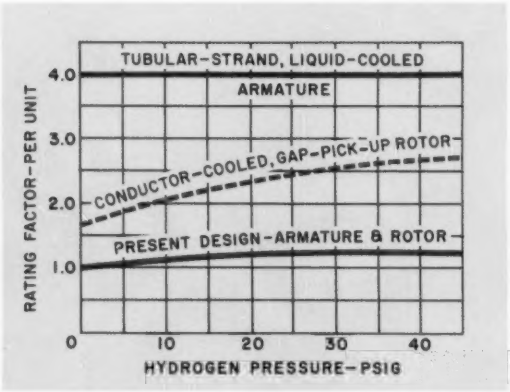
THIS DESIGN IS THE MOST EFFECTIVE method of cooling yet developed. Combined with the new conductor-cooled, gap pick-up type rotor, a typical unit's rating may be doubled without appreciable increase in physical size.



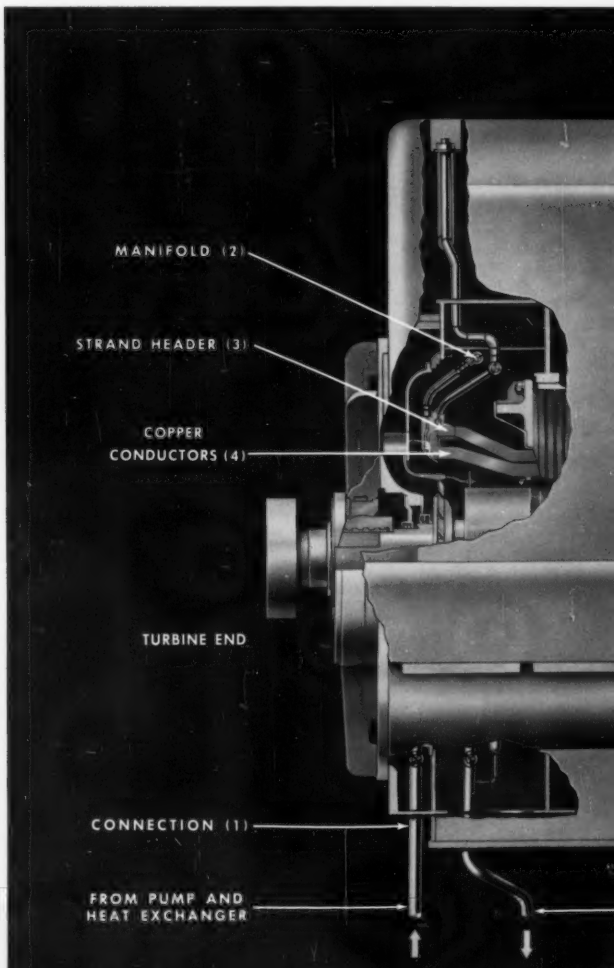
CROSS-SECTION OF ARMATURE BAR shows hollow tubular conductors which carry liquid coolant as well as current. Maximum heat removal is possible because of direct contact between cooling liquid and conductors.



COOLING LIQUID enters tubular conductors through strand header at end of armature bars. Cut-open section above shows how conductors are brazed to header.



HIGHER CAPACITIES are possible with new G-E conductor cooling development. Bringing liquid coolant in direct contact with the armature conductors can remove as much as sixteen times the heat that could be removed from them through the normal ground insulation with the same copper temperature.



can double generator rating

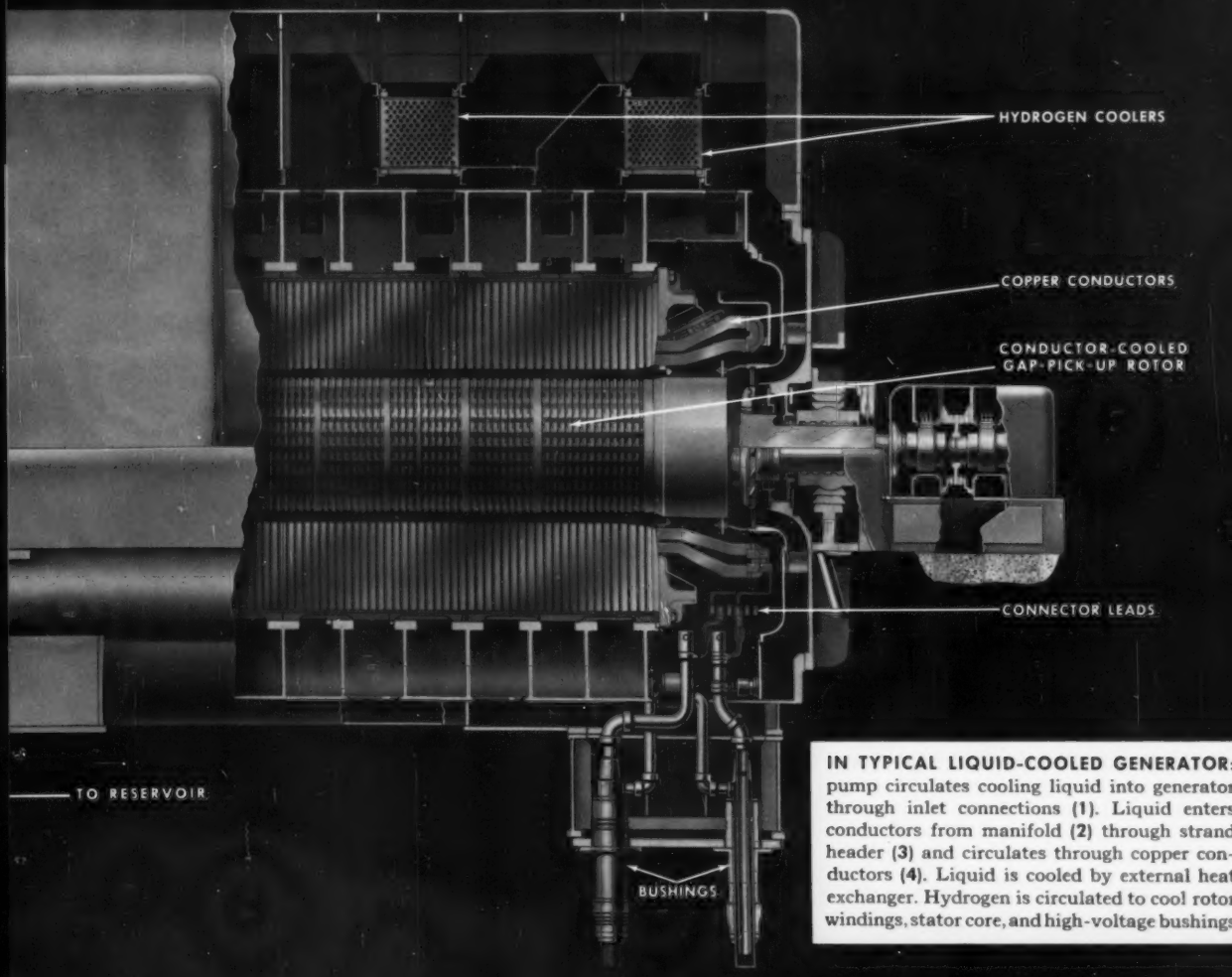
increase in physical size

Even with the increased current output made possible by liquid cooling, efficiency of this General Electric unit remains high. Design features such as: extra transposition of end windings; copper shields on the stator core clamping flanges; and machine dimensions specially designed to reduce windage losses, all contribute to this high efficiency.

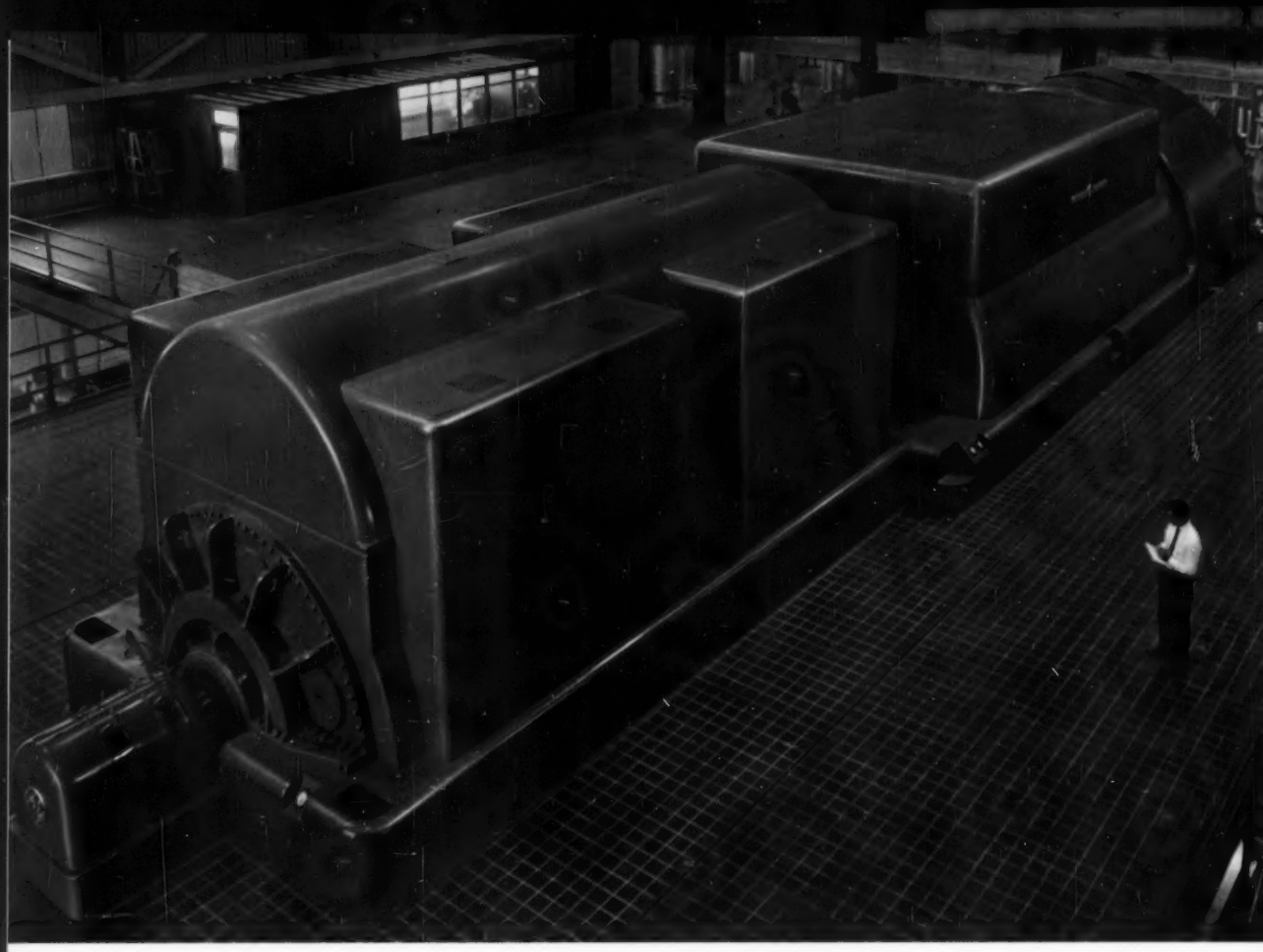
The coolant circulates in a double wall guarded circuit within the armature frame. A special brazed header provides permanent joining of tubular armature conductor strands. Both the liquid and the parts enclosing the coolant are carefully selected for non-corrosive characteristics.

This 260,000-kva, 30 PSIG Eastlake generator is the largest so rated 3600-rpm generator in the world. The new design developed for Eastlake is a significant step toward doubling generator ratings without appreciable increase in frame size and points the way to much larger machines—as high as 500,000-kva. For more information write for GER-1231, "Liquid Cooling of Turbine-Generator Armature Windings," Large Steam Turbine-Generator Department, General Electric Company, Schenectady 5, New York.

GENERAL ELECTRIC



IN TYPICAL LIQUID-COOLED GENERATOR: pump circulates cooling liquid into generator through inlet connections (1). Liquid enters conductors from manifold (2) through strand header (3) and circulates through copper conductors (4). Liquid is cooled by external heat exchanger. Hydrogen is circulated to cool rotor windings, stator core, and high-voltage bushings.



New generator produces 66% more power in same turbine room space

Eastlake's new General Electric conductor-cooled 260,000-kva generator (above) represents another milestone in turbine-generator progress. The new generator has increased station capacity 56% yet occupies the same turbine room space as each of the three other conventionally cooled, 156,250-kva General Electric units in this modern plant.

Obtaining more kilowatts in the same turbine room space is one of the many challenges created by the increasing expansion of electric utility loads. The Eastlake installation demonstrates how this challenge can be solved by advanced designs.

It is a typical example of how the electric utility industry and equipment manufacturers are cooperating to meet tomorrow's demand for larger blocks of power with turbine-generators of even higher ratings.

This latest expansion of the Eastlake plant is a further step in Cleveland Electric Illuminating Company's program of helping its customers to Live Better ...Electrically. 254-45

LIVE BETTER ELECTRICALLY

Progress Is Our Most Important Product

GENERAL ELECTRIC

SYSTEM ENGINEERING—Protection

Disconnect Switches Controlled Remotely

E. T. FISCHER, Electrical Engineering Division, Philadelphia Electric Co, Philadelphia, Pa.

The economic feasibility of extending remote control of 33-kv line disconnect switches to more locations on its widespread 33-kv network is being explored today by the Philadelphia Electric Co. This study is the sequal of a two-year operating trial which proved the practicability of such remote control.

During the trial period, the utility, with the cooperation of Bell Telephone Co of Pennsylvania and Bell Laboratories, compiled an operating record of such a system under all conditions. It shows that a remote control system substantially reduces outage and maintenance switching times.

Dummy Switches Included

Trial installations were set up on six strategically situated 33-kv line disconnect switches, so that Bell Laboratory's control and the utility's operating equipment could be evaluated, along with the operating advantages of remote control under operating conditions. During the trial all switches were exercised on a weekly schedule, such operation being additional to their emergency and maintenance functioning. Control of three dummy switches allowed further study.

Control equipment consisted of a dispatch cabinet, a 48-v battery cabinet, a control cabinet for the three dummy switches at the main station, and a control cabinet at each of the remote control locations. The control system designed by Bell Laboratories is a digital one based on long and short pulses. A maximum of 50 devices may be controlled on a single channel (100 functions, close and trip).

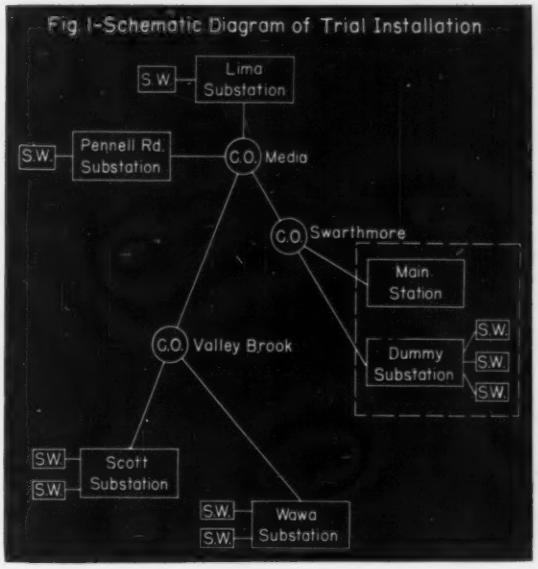
The present design allows as many as ten devices to be controlled at any single remote location without duplication of the remote control common equipment. The supervisory or pulsing signals may be sent over "voice" or telegraphic channels, so that established telephone facilities to all locations can be used.

Switch Positions Indicated

The dispatch cabinet at the main station has "close," "trip," and "inquiry" buttons for each controlled switch, with associated red, green, and amber lights, respectively. The position of each controlled switch is indicated continuously by the red (closed) or green (open) indicating lights. An inquiry to determine the position of any controlled device may be made at any time. A roll call, automatically checking the position of all controlled devices, may be set to perform at any desired interval.

Every order (close or trip), inquiry, or roll call sent from the main station consists of two five-pulse digits. To obviate incorrect operations, as all signals are sent to all remote stations, each order is checked as sent by emitting two series of two five-pulse digits automatically when an order is initiated. Both series must be received identically by the proper remote station equipment before action is taken to change the position of the controlled switch. The control equipment does not function to change the position of any switch when interference lengthens or shortens the duration of any pulse of the order or order check series.

Fig. 1-Schematic Diagram of Trial Installation



Operator Is Alerted

Visual and audible alarms are initiated at the main station by the manual or automatic change of position of any remotely controlled device. The alarms may be retired independently. All alarms automatically call for a complete roll call after their reception.

Telephone pairs are monitored at regular intervals by the automatic roll call. Failure to receive a reply from a remote station after an order or inquiry produces a "no-reply" amber lamp on the dispatch cabinet, alerting

LIMA INSTALLATION has pole-mounted spring mechanism, and the white cabinet contains the remote control equipment

the operator to possible outage of the control pair or of the remote control equipment.

All components of the control equipment have been designed as plug-in units to faciliate servicing, maintenance, or field replacement.

At each remote location Philadelphia Electric's equipment consists of the following:

1. Disconnect switches. Existing 33-kv vertical disconnect switches were equipped for remote control.

2. Spring operating mechanisms. Each controlled switch has a motor-wound, spring-operating mechanism.

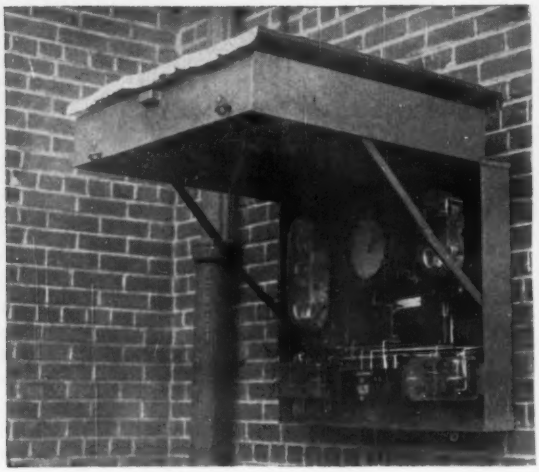
The spring mechanisms consist of a motor-operated gear drive which winds sufficient energy for four switch operations into the lower end of two vertically mounted concentric torsion springs. This energy is released for switch operation at the top of the springs by two solenoid-operated latches. A hydraulic retard device in the mechanism controls the output speed of the springs to prevent damage to the controlled switch. The retard device may be adjusted to obtain any of several operating speeds and serves to maintain the operating speed constant for the four operations of the mechanism.

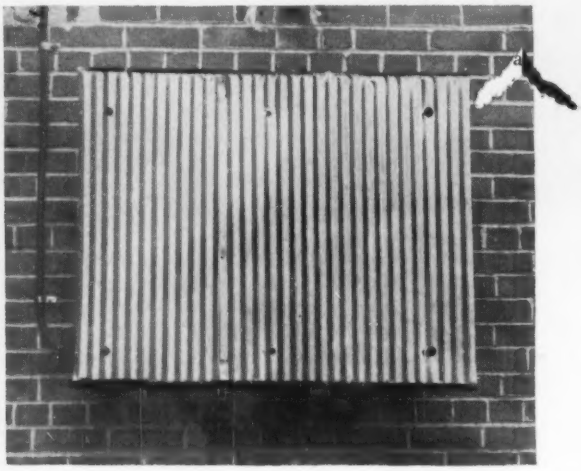
The rewind motor, operated on 115 v ac, starts to rewind the mechanism after the first switch operation when potential is available. The solenoid-operated latches, governing release of the spring energy, operate on three 6-v, "hot-shot" batteries in series which are supplied as an integral part of the spring mechanism. To facilitate maintenance and servicing, the spring mechanisms may be operated electrically or manually at the remote location, either disconnected from or connected to the switches they normally operate.

Since installation, there have been no difficulties with operation of the spring mechanisms.

3. Control battery. The 48-v dc source for operation of the control equipment was installed at each remote location by the power company. Different types of batteries and battery auxiliary equipments were installed at each two of the four remote locations for evaluation before the end of the trial period.

METERING—Maintenance





Cabinet Sun Shield Saves Wax Charts

V. W. HINTON and **M. M. STAMBAUGH**, Appalachian Electric power Co, Pulaski, Va.

Shielding outdoor metal cabinets from the sun's rays by means of corrugated aluminum sheeting halts the melting and consequent erasure of recording demand meter wax charts. Resorting to this procedure last year, Appalachian Electric Power Co obtained satisfactory wax-coated chart records through July, August, and September, the area's hottest months.

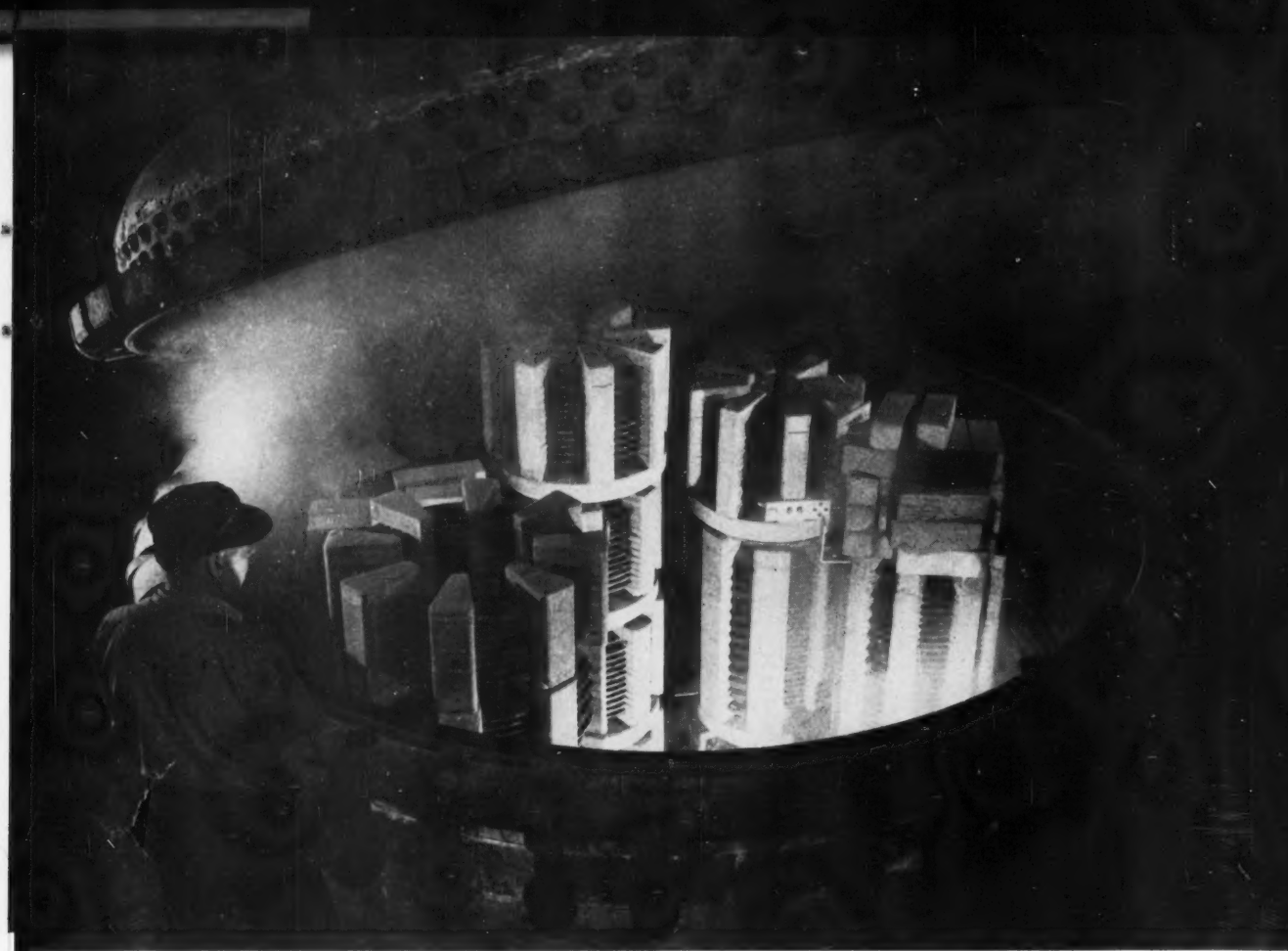
Estimated cost of the shields was less than $5 per installation. Other methods which did not solve the problem, cost as much as $50. Other sheet metals, such as galvanized sheeting or roofing, might serve as well. Aluminum was selected because of its light weight and availability.

Ever since the first use of wax-coated charts with demand meters, considerable difficulty was experienced with them in outdoor metal cabinets exposed to the sun. When sufficient heat builds up inside the cabinets, the wax coating on the charts melts and erases any demands recorded on the face. The temperature inside these cabinets during the summer has risen higher than 100F.

Damaged charts, particularly those recording demands of large power customers, lead to errors in readings and corresponding billings, causing increased billing expense, possible loss of revenue, or customer complaints—all increasing operating expense.

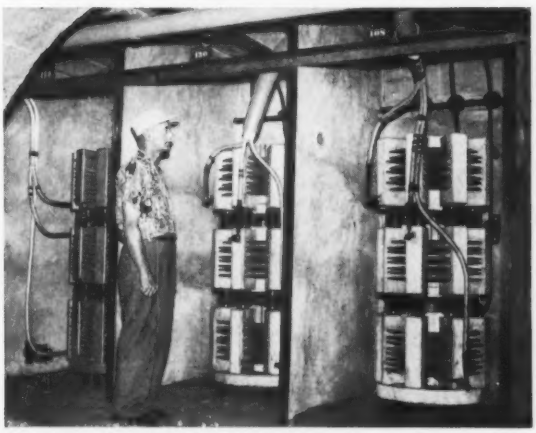
Relocation of outdoor meter cabinets for customers' or company substations is very expensive.

(*Continued on page* 169)



PROVEN WET-STEAM CURING PROCESS MAKES

General Electric cast-in-concrete reactors stronger, more reliable



37 YEARS OF SERVICE have been achieved by these G-E cast-in-concrete reactors at Fall River Electric Light Co., Fall River, Mass. Twelve reactors, installed in 1919, are as strong as ever and have required practically no maintenance.

RELIABILITY that begins at the moment of installation and lasts through a longer life is assured to you by General Electric's time-proven methods of manufacturing cast-in-concrete reactors. Using its exclusive wet-steam curing process, G.E. achieves in two days a degree of concrete curing which would be obtained only after several weeks of normal, in-service curing. This unique 180° C steam bath gives you stronger, more reliable reactors than any other curing method in use today.

PROOF OF THE STRENGTH of properly cured concrete reactors is demonstrated daily by thousands of G-E reactors in service across the country (see photo left). For other benefits of G-E reactors, contact your local G-E Apparatus Sales Office or write General Electric Company, Schenectady 5, New York. 422-32

Progress Is Our Most Important Product

GENERAL ELECTRIC

All the features you asked for make

1956

RM* Medium Transformers

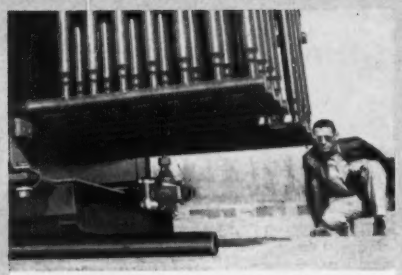
Your Best Buy

For further information on G-E Medium Transformers, contact your nearest G-E Apparatus Sales Office, or write Section 416-6, General Electric Company, Schenectady 5, N. Y.

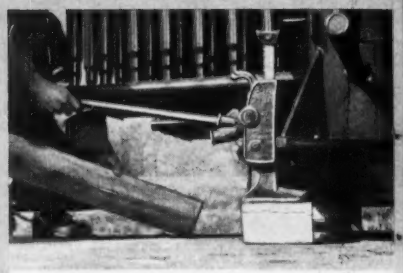
*Repetitive Manufacture

Progress Is Our Most Important Product

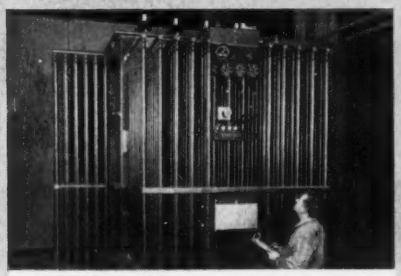
GENERAL ELECTRIC



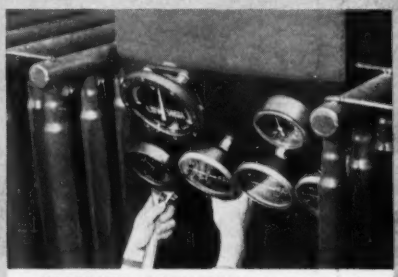
SLED-RUNNER BASE on all G-E RM transformers slides easily or rides smoothly over rollers, makes installation simpler. Wide face on I-beam will not cut rollers.



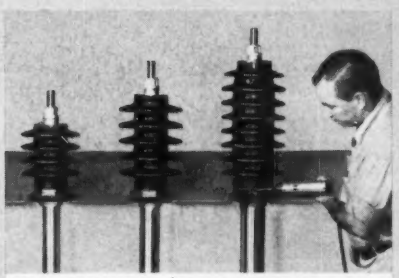
LIBERAL JACKING SPACE cuts installation time and effort. Minimum of 5½ inches between jackpad and ground provides more-than-adequate clearance for most jacks.



CONTROL CENTER groups all instruments and nameplate in one easy-to-see area; improves visibility, makes readings extra simple. Chances of error are reduced.

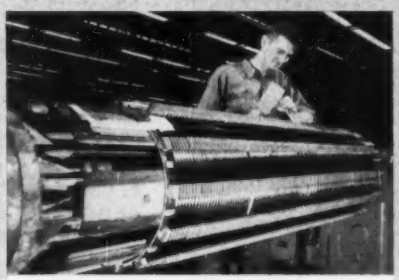


PROTECTED ACCESSORIES are recessed behind cooling tubes, sheltered against damage from blows that might be encountered during shipping and installation.

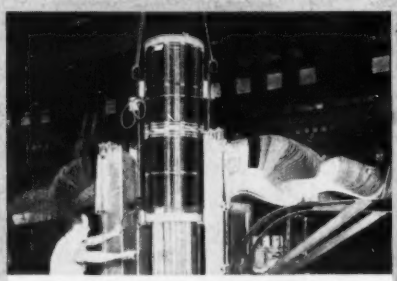


AMERICAN STANDARD BUSHINGS, used on all General Electric Repetitive Manufacture Medium Transformers, enable you to reduce your bushing inventories.

FULL DRAIN permits complete filtration, removes worst bottom oil. Sampling is more accurate, since sample is drawn from region of greatest contamination.

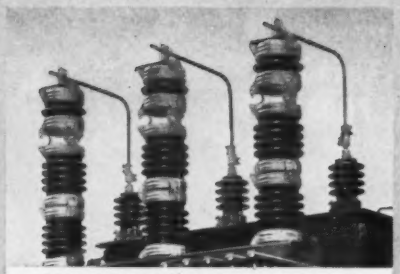


FORMEX* insulation is extremely rugged, has phenomenally high dielectric strength. Permits more compact, lighter RM transformers. *Reg. Trade-mark G.E. Co.

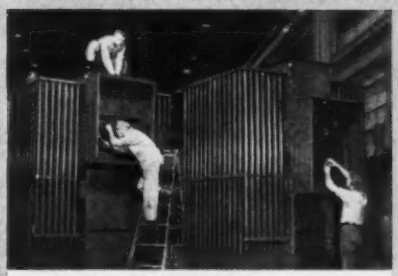


PRE-FORMED CORE, used in single-phase RM medium transformers, reduces core losses since magnetic flux path follows grain in core laminations, even at corners.

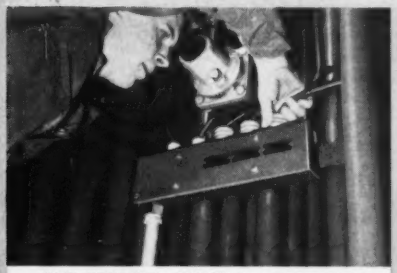
VENTILATED BASE permits free air circulation, helps prevent moisture from condensing under transformer, minimizes rusting and corrosion in this hard-to-reach area.



PRE-FITTED CONNECTORS between bushings and G-E Magne-valve lightning arresters simplify field installation, give better lightning protection.



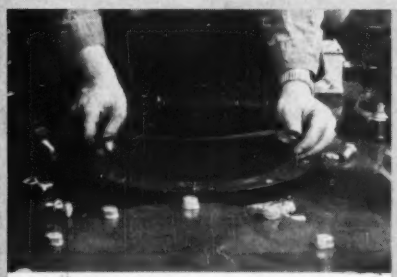
REVERSIBLE JUNCTION BOX readily adapts to overhead or underground system, simplifies ordering and interchangeability, provides additional flexibility.



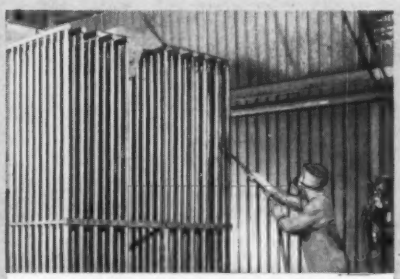
ONE CONTROL CONDUIT simplifies field wiring of accessories and controls. Connections for entire transformer are made to a single terminal board, shown above.

TILTED INDICATORS. Where control center group is sufficiently high above ground, indicators are tilted at proper angle to make instrument reading easier, more accurate.

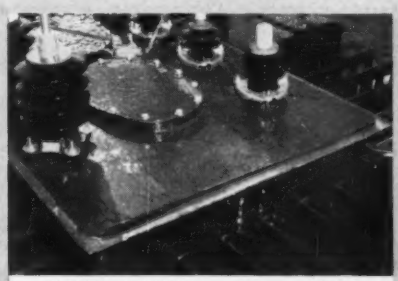
CONDUITS AND FITTINGS for all control wiring are weather-tight, can be field assembled in minutes without cutting threads. Cover plate gasket is re-usable Nitrile.



NITRILE GASKETS resist weathering, seal without adhesives; no chipping required for removal. Re-usable again and again, they permit reduction of gasket inventories.

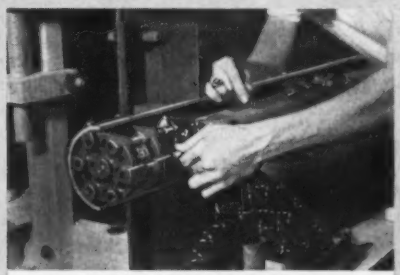


SUPER MELAGLYP FINISH saves up to two repaintings, is longer lasting in corrosive atmospheres. Metal is specially prepared for better adhesion, more uniform coating.



DOMED COVERS let water run off, help prevent dirt and rust from accumulating. Flanges around openings prevent foreign matter or moisture from rolling into tank.

SPRAY-ON PAINT, provided with every RM transformer, permits touching up of spots chipped or scraped during shipment or installation, before rust gets foothold.



WEDGE-TYPE TAP CHANGERS have rugged self-aligning contacts with wedging action to assure line contact. They can carry transformer's full-rated short-circuit current.

LARGER MANHOLES, introduced this year, mean easier accessibility to interior; allow easier and more accurate inspections. Even a husky man has plenty of room.

GENERAL ELECTRIC

New General Electric Atomic Lab to Help Cut Cost of Nuclear Power

The new General Electric Vallecitos Atomic Laboratory in Pleasanton, California, will develop and test new ideas aimed at reducing the cost of atomic-generated electric power.

The new laboratory, to begin operation in 1957, will initially consist of a Critical Assemblies Building (1), a Radioactive Materials Lab. (2), and a full-scale developmental Boiling Water Reactor (3).

The Boiling Water Reactor will permit tests of both natural and forced circulation, core configuration experiments, and either single- or dual-cycle operation. Steam produced in this reactor will also be used, through a joint arrangement with Pacific Gas & Electric Co., to generate the first all-privately-financed atomic-electric power.

The Vallecitos Atomic Laboratory is further evidence that General Electric will maintain engineering leadership in the field of atomic energy.

Atomic Power Equipment Department, General Electric Company, Schenectady, N. Y. 196-2

Progress Is Our Most Important Product

GENERAL ELECTRIC

Shields Wax Charts

(*Continued from page* 164)

Ventilation holes in the bottom and sides near the roof have avoided trouble with wooden cabinets. Screen wire and small rain shields protect the holes sufficiently. But this method does not work with metal cabinets. Use of insulating materials was not successful, and the installation of small fans was discussed and dropped.

In installing the aluminum shields, a 2-in. space was left between the aluminum sheeting and the box lid to serve as a heat barrier and provide ventilation. The sheeting was attached to the lid by 4-in. galvanized, full-threaded bolts and lock nuts inside and outside the box lid and back of the 1-in. aluminum strips holding the sheeting in place. Alignment of the bolts 10 to 12-in. apart across the top and bottom afforded spacing.

The sheeting was bent over at the top and bottom edges to prevent hand and arm cuts during opening or closing of the cabinets.

GENERATION—Maintenance

Grinds Safety Valve Better, Easier

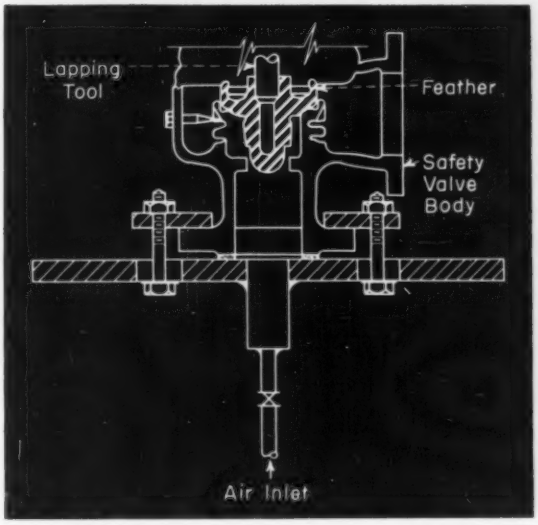
GEORGE SPANGLER, Harding Street Plant Superintendent, Indianapolis Power & Light Co, Indianapolis, Ind.

Grinding safety valves has been made easier and the valve grinding job has been improved through the use of a pneumatic balancer. The balancer was developed and is used by the crew of the Harding Street plant of the Indianapolis Power & Light Co.

The balancer consists of a mounting plate, drilled to permit passage of compressed air under the safety valve feather. A coupling serves as an air chamber, and an air supply with needle valve was welded to the plate.

Just enough air is admitted to balance the combined weight of the valve feather and the lapping tool. This provision maintains a more uniform contact pressure between the base seat and the feather than could formerly be held by using the old spring and "feel" technique. The result is a better job of valve grinding in less time.

Bolt holes in the balancer plate are elongated so that clamps can be adjusted for various size valve flanges.



PNEUMATIC BALANCER holds safety valve while it is being ground. Controlled air pressure maintains even pressure on valve during grinding operation, results in better job

DISTRIBUTION—Construction

Power Auger Installs Light Posts Cheaper

R. K. WOODSON, Assistant Superintendent, Underground Department, Kansas City Power & Light Co, Kansas City, Mo.

Modernization and streamlining of methods for installing bases for street light posts has reduced man-hours to 25% of previous requirements on the Kansas City Power & Light Co system. Man-hours for the posts themselves have been reduced through mechanization also.

Formerly the hole was dug by hand, and a rig, consisting of a material and water truck and concrete mixer, poured the base.

Today, a power auger digs the hole 5½ ft deep instead of 24 in., and a ready-mixed concrete truck pours the base.

The power auger does not have to be positioned exactly to dig the hole. The digger can be rotated on the back of the truck and digs in any part of a circle not covered by the truck bed during the digging process.

The truck may be run along the curb, and the holes dug in the parkway where desired. All controls are hydraulic, and the upper part of the auger may be tilted at any angle to clear tree limbs or other obstructions. Only solid rock stops rotation of the bit. In reasonably hard going this machine digs a 5½ ft hole, moves 200 ft to another, and is ready to dig again in less than 5 min.

In setting street light posts, only half of the man-hours are required when a device similar to the mobile scoop is used instead of the older "strong-arm" methods. The post is completely wired on the ground, and its upper part painted before erection. Posts 200 ft apart can be set easily, one every 5 min.

(*More How To on page* 172)

5-Kv Preassembled Aerial Cable

Types, general instructions for installation, and cable specifications are adapted from Distribution Standards of New England Electric System

General Instructions

1. TYPE

Two types of cable:

Type I—Rubber insulated, Neoprene jacketed, non-shielded.

Type II—Rubber insulated, shielded, non-jacketed.

Type I cable is recommended for cable sizes up to No. 3 copper inclusive. For larger sizes either Type I or II may be used. (Engineering recommendations shall be obtained).

2. CABLE TERMINATIONS

Procedure for terminating Type I cable (non-shielded) and for Type II cable (shielded) are outlined separately in the System's Distribution Standards.

3. GROUNDING

a. Aerial Cable Messenger. Messenger shall be grounded at all terminations, at all transformer locations (use arrester ground) and at intervals along the run of the cable so that there will be no section of the cable run exceeding 800 ft which will be ungrounded.

b. Open Wire Neutral. If open wire primary exists between the station and the aerial cable, the neutral of the open wire section of the feeder shall be multi-grounded.

c. Neutral of Open Wire Extensions. Extensions from aerial cable may be uni-grounded or multi-grounded depending on the established practice in the open-wire area.

4. LIGHTING ARRESTER

a. Phase Arrester—Lightning arresters shall be installed at all terminations and open wire taps.

b. Neutral Arrester—Since the installation of aerial cable employs a multi-grounded neutral system (messenger grounded at least every 800 ft) neutral arresters will not be installed. Neutral arresters shall also be removed and/or omitted in the open wire section of the feeder between aerial cable and station.

5. EXISTING OPEN WIRE TAPS FROM AERIAL CABLE

Grounding of open wire neutral every 1,300 ft and removal of neutral arrester is recommended but left to discretion of local company.

6. LOCATION OF CABLE ATTACHMENT ON POLE

Normally the aerial cable shall be installed on the street or road side of the pole. However, in some instances it will be more advantageous to install cable on field side of pole such as at transformer locations and at inside angles of corner poles or to avoid trees.

7. ENERGIZING

After construction is completed, the cable should be energized at line voltage through fuses (or breaker) for a period of 24 hr before adding load.

Cable Specifications

Complete Assembly			Copperweld Messenger			
Description	Lb Per M Ft	Max. Reel Length, ft	Size in.	Type	Ohms per M ft	Breaking Strength, lb
1/c–No. 6 Cu	622	2,000	3/8	40% H.S.	0.2312	10,460
3/c–No. 3 Cu	1,616	1,500	3/8	40% H.S.	0.2312	10,460
3/c–No. 1/0 Cu	2,075	1,000	3/8	40% H.S.	0.2312	10,460
3/c–No. 4/0 Cu	3,490	1,000	1/2	30% E.H.S.	0.1938	20,460
3/c–300M Al	2,950	1,000	1/2	30% E.H.S.	0.1938	20,460

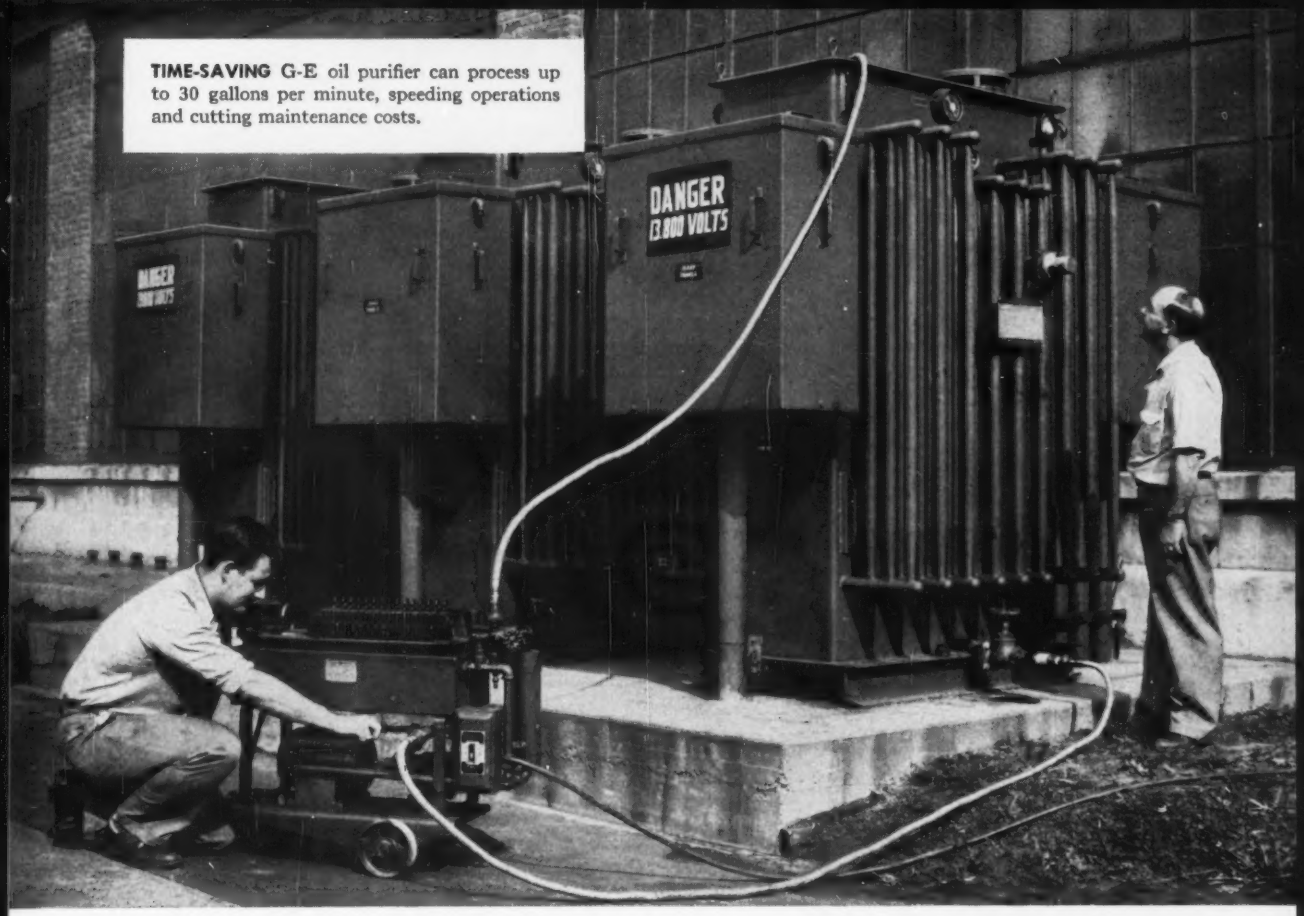
Insulated Conductor								
No.	Size, Awg	Type	Strds	Rubb. 64th	Neo. 64th	Shielding Tape, in.	Binding Tape Cap., S.D.	Cu, in.	amp
One	6	Cu	7	10	4	None	5/16×0.030		85
Three	3	Cu	19	10	4	None	5/16×0.030		115
Three	1/0	Cu	37	10	None	3/4×0.005	5/16×0.030		165
Three	4/0	Cu	37	10	None	3/4×0.005	3/8×0.040		250
Three	300M	Al	61	11	None	3/4×0.005	3/8×0.040		263

Notes for Conductors

1. Copper Conductors: Soft drawn lead alloy coated copper.
2. Aluminum Conductors: Medium hard drawn all aluminum. A. S. T. M. Spec. B231-48T.
3. Conducting Tape Over Conductors (non-shielded cable only): Layer of conducting cotton sheeted tape over the copper conductors.
4. Insulating Wall: Ozone resistant rubber A. S. T. M. Spec. EAD 574. 70 C maximum continues operating temperature of conductors.
5. Conducting Tape Over Insulation (shielded cable only): Layer of semi-conducting cotton sheeted tape over factory insulation.
6. Neoprene Jacket: Non-conducting ozone resistant neoprene compound for non-shielded cable. A. S. T. M. Specs. D752 and D574.
7. Shielding Tape: Ambrac with 20% nickel content; applied with a positive lap of not less than 3/16 in.
8. Lay of Cable: 1/c cable is parallel lay; for all other cables the insulated conductors to be twisted in a reverse lay.
9. Phase Identification: This shall be included on all cables, using one of the following to suit the type of cable:

Phase	Color Code	Number Code	Letter Code	Ridge Code	Color Code*
A	Red	1	A	One ridge	Red
B	Green	2	B	Tow ridges	Green
C	Black	3	C	Three ridges	White

* This is internal marking to be used only where a thin colored layer of neoprene is provided between factory insulation and outside jacket of black neoprene.



TIME-SAVING G-E oil purifier can process up to 30 gallons per minute, speeding operations and cutting maintenance costs.

Cut maintenance costs with G-E Purifiers

Recondition insulating liquids quickly and easily with this low-cost device

You may be able to cut your maintenance costs in filtering insulating liquids for transformers, regulators, and other electrical equipment by using General Electric purifiers for oil and Pyranol*. The purifiers, which filter out suspended sediment and free and dissolved water, have high capacity, do high-quality work, and are easy to use.

It is important, of course, to filter the insulating liquid when filling a tank for the first time, or when refilling an old tank. Maintenance of dielectric strength is more important today than ever before because many users are ordering transformers with reduced basic insulation levels. If periodic testing indicates a need for filtering, the G-E purifier will do the job, safeguarding equipment life and helping to assure continuous service to customers.

High Capacity—The new G-E oil purifier with 7-inch filter-paper plates has a capacity of 12 gallons of liquid per minute, a 20 per cent increase over other available models. This means rapid filtration, short shutdowns, and low maintenance costs. The model for purifying Pyranol has similar output. Models, using 12-inch filter-paper plates, filter 30 gallons per minute.

High-quality Work—Using adequately dried filter paper, you can normally raise the dielectric strength of oil to be reconditioned to 30 kv with just one pass through the purifier.

Easy to Use—Simplicity of operation saves time in training maintenance crews. Unskilled workmen can easily set up and operate G-E purifiers. The single-phase pump motors operate on 115/230 volts, and the filter-paper drying ovens used in conjunction with the equipment are rated for either 115/230 volts or 230/460 volts. Purifiers and ovens can be quickly connected either to single-phase lighting circuits or to one phase of a three-phase circuit.

For More Details—For complete information on low-cost G-E purifiers for oil and Pyranol, drying ovens, and filter paper, contact your nearest G-E Apparatus Sales Office, or write for Bulletin GEA-1333, Section 431-45, General Electric Company, Schenectady, New York.

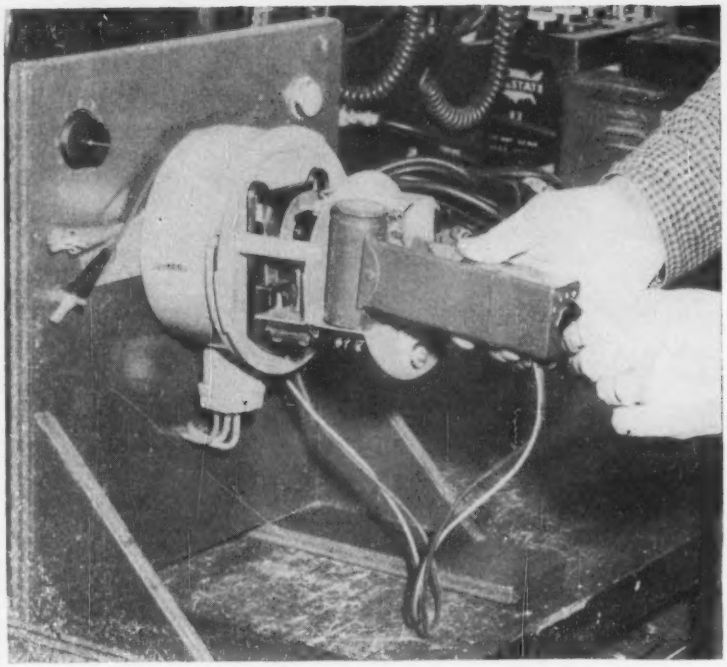
*Registered trade mark of General Electric Company.

Progress Is Our Most Important Product

GENERAL ELECTRIC

Street-Light Relay Tester Compact, Not Costly

CONRAD SHIELDS and **JAMES CONNOR**, Station Men "A", Indiana & Michigan Electric Co, Marion, Ind.



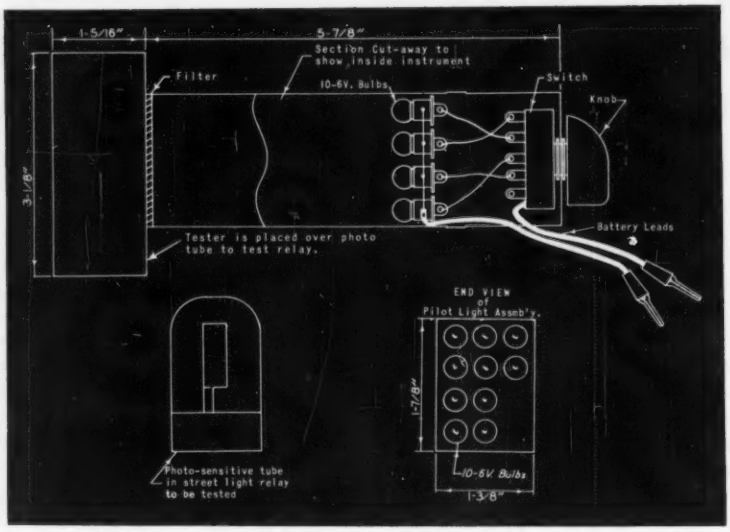
Street-light relays have to be tested periodically to make sure that they turn on the lights when natural illumination drops below a prescribed value and turn them off again when the illumination rises sufficiently above the prescribed value. The prescribed limits permit some leeway so that absolutely accurate light intensities are not essential for the "On-Off" tests.

Yet these limits must be standardized so that adjacent sections of lights do not shut off or come on at widely different times. No suitable commercial device is known for checking proper response of light relays to natural light intensities, although one manufacturer's service manual illustrates how one can be assembled. The device described, however, is large and expensive and requires many special parts, such as an expensive light meter and a cooling blower.

Meter-Base Socket Used

The relay test stand and adjustable light source illustrated here were developed for testing and adjusting the assembled photoelectric light control, but not the individual photoelectric tubes. A meter-base socket is used for mounting the relay. The pilot light in the upper right corner indicates when the relay opens and closes the light circuit.

The hood held over the photoelectric tube permits applying various light intensities from 1 to 4 ft-c. The features of the light source are illustrated. The entire test set is compact, adjustabie, and costs only $6 plus 5 man-hours to construct it largely from scrap material and equipment readily available.



Gives 1-Ft-C Intensity

To check a street-light relay, it is inserted in the socket receptacle, the cover removed, the light source connected to a 6-v battery and placed over the "eye-tube" (light-collecting tube). After allowing sufficient warm-up time, the multi-position switch on the end of the light source is turned to position 1 with the vernier rheostat in the shorted position. This gives approximately 1 ft-c of diffused, blue-white light on the filter viewed by the eye tube.

That intensity is enough to close most street-light relays. If not enough, positions 2 or 3 must be used. But, if the switch has to be turned to positions 3 or 4, the street-light relay is not very sensitive and there is probably a defect in it.

A log should be kept of the switch and vernier settings to open and close

(*Continued on page* 177)

We agree with Dave—

using clean PENTA-treated crossarms makes sense

We were putting up our first batch of PENTA*-treated crossarms the other day when Dave dropped by. Dave's our purchasing man, and a man who knows his business. And I figured it would be a good time to find out why he switched us to treated crossarms, so I asked him "how come?"

Dave explained that we wanted the crossarms to last as long as the poles, and the best way to get that sort of service life would be to put PENTA-treated crossarms on PENTA-treated poles. That would mean a cut in replacement costs. Also, insulator pins stay put longer because PENTA prevents rot damage to the wood around the pins. And the bolts hold better, too, for the same reason.

I agreed that treated crossarms sound like good common sense . . . and from the crew's standpoint, I was glad the preservative was PENTA, because it's so clean and easy to handle, even in hot weather.

When Dave told me PENTA-treated crossarms don't cost a penny more than other treated crossarms, I had the whole story. Easy to see why we're going to specify PENTA on all orders for poles and crossarms from now on. Matter of fact, sounds like a good idea for other utility companies, too. THE DOW CHEMICAL COMPANY, Midland, Michigan, Department PE 983A.

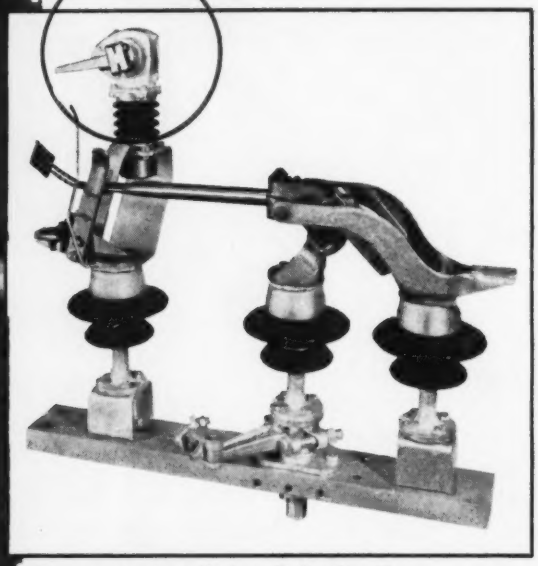
* Pentachlorophenol

you can depend on DOW CHEMICALS

DOW

NOW

DELTA-STAR'S



Powerupter installed on Delta-Star Type MK-40 Braidless Vertical Break Switch equipped with powerful ice and corrosion-breaking blade movement.

Powerupter unit is actuated by switch blade movement, providing instant circuit interruption without external arc or flame.

Applications: For interrupting load currents, magnetizing currents, charging currents.

Capacities: 7.5 through 34.5 kv voltages; 600 amp interrupting capacity; 400, 600, 1,200 and 2000 amp continuous current ratings and in combination with fuses.

For all the facts, write Delta-Star or

DELTA-STAR
H. K. PORTER

2437 Fulton St., Chicago 12, Illinois

Canadian Affiliate: **Canadian Line**

Other divisions of H. K. Porter Company, Inc., are: Alloy Metal Wire, McLain Fire Brick, Quaker Pioneer Rubber, Quaker Rubber,

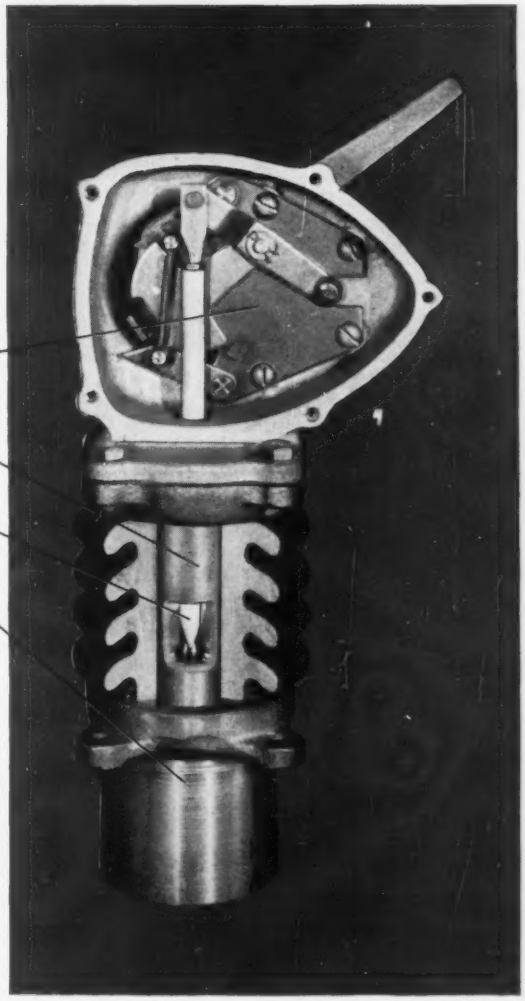
Available for improved service

New *Powerupter* Switch

Voltage ratings from 7.5 kv through 34.5 kv—built with exclusive Delta-Star's features

This new Delta-Star development combines a new interrupting device with the most modern disconnecting switches. The Powerupter is an interrupting device of heavy duty and sturdy construction throughout. It features an exclusive automatic trip, with instant breaking and making speeds independent of switch operation. Important original features of Delta-Star Switches are not sacrificed. All important characteristics are retained.

Cutaway view shows *Powerupter* operating advantages

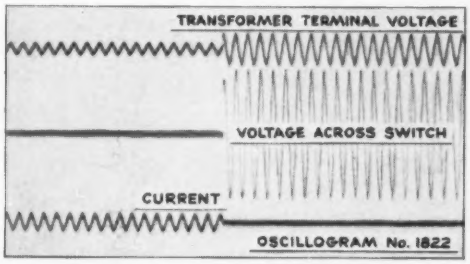


Powerful, high speed mechanism draws moving contact with follower in straight line. Speed of operation independent of speed of switch operation.

Arcing chamber lined with gas-evolving material. Chamber contains stationary contact and moving contact.

Follower made of gas-evolving material and drawn up into arcing chamber—insuring rapid arc extinction for all current values.

Exhaust chamber provided with muffler—to confine and cool exhaust gases released from interrupting chamber.



Typical oscillogram made during interrupting test of Delta-Star's Powerupter at 15 kv.

ask your Delta-Star representative.

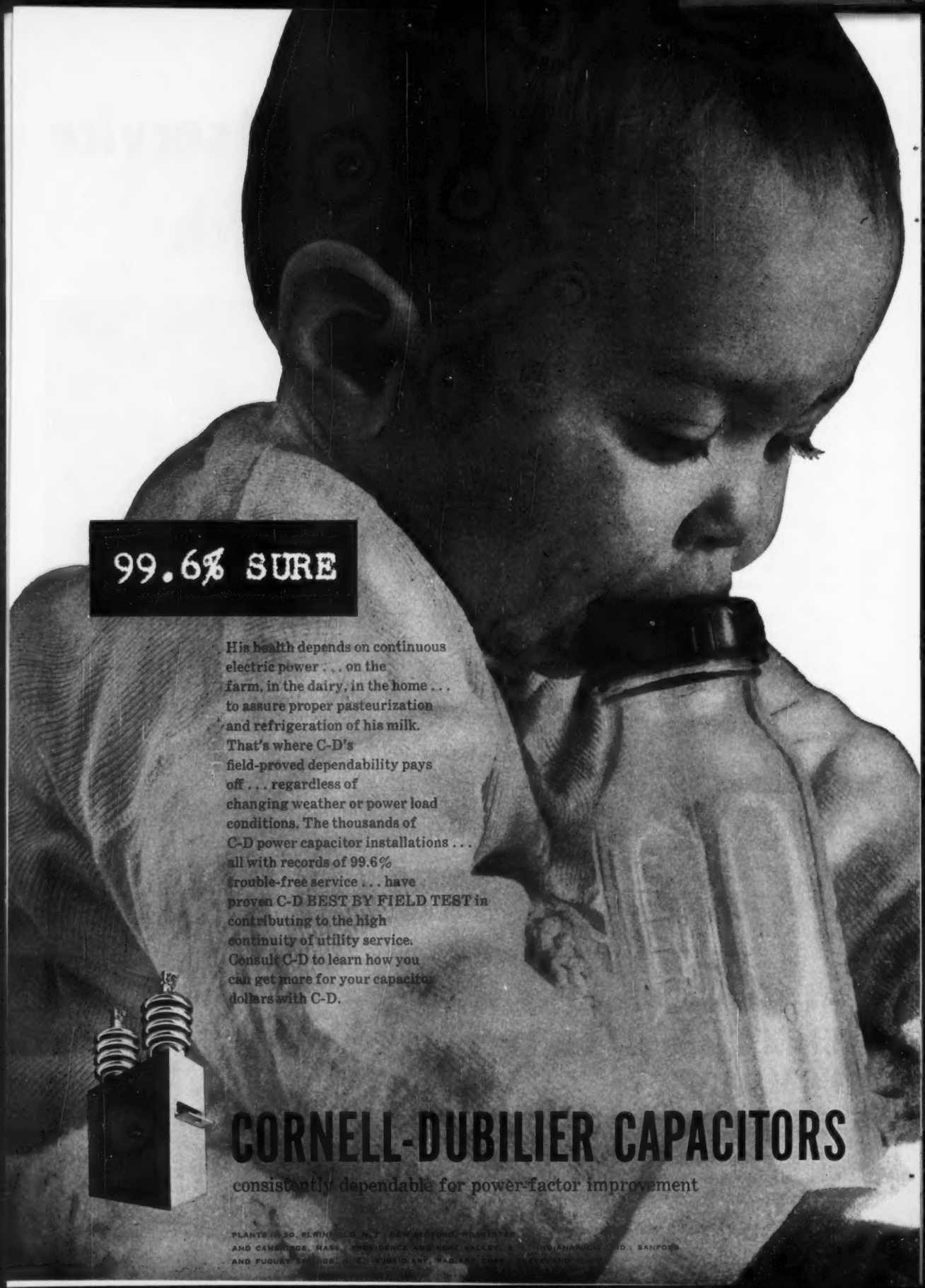
ELECTRIC DIVISION COMPANY, INC.

District offices in principal cities

Materials, Ltd., Toronto, Ontario

Connors Steel, Esaco, Henry Disston, Laclede-Christy, Leschen Wire Rope, Riverside Metal, Vulcan Crucible Steel, W-S Fittings

HKP


99.6% SURE
His health depends on continuous electric power . . . on the farm, in the dairy, in the home . . . to assure proper pasteurization and refrigeration of his milk. That's where C-D's field-proved dependability pays off . . . regardless of changing weather or power load conditions. The thousands of C-D power capacitor installations . . . all with records of 99.6% trouble-free service . . . have proven C-D BEST BY FIELD TEST in contributing to the high continuity of utility service. Consult C-D to learn how you can get more for your capacitor dollars with C-D.
CORNELL-DUBILIER CAPACITORS
consistently dependable for power-factor improvement

CORNELL-DUBILIER
power-factor capacitors give you better than 99.6% trouble-free service*

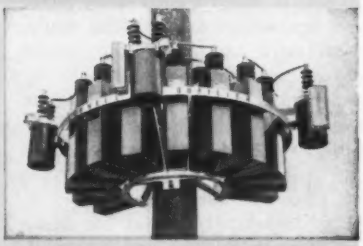
Lowest volts per mil unit stress results in the extra margin of safety necessary to withstand all system high voltage transients. This lower volts per mil and lower volts per section feature is the utility's assurance of extra longevity in its capacitor purchase when Cornell-Dubilier's are specified.

Only C-D power capacitors are subjected to a full-rated voltage energization test. C-D removes potential trouble-makers before they get on your poles . . . not after with costly replacements.

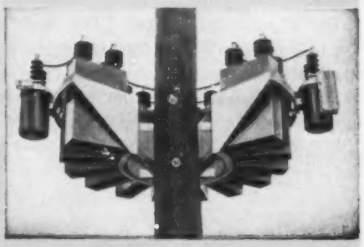
Lowest unit dielectric stress not only provides lowest voltage gradient for steady state operating conditions, but also highest withstand protection against the transients produced by lightning, circuit breaker re-strikes and all other line surges.

Heavy major insulation in the form of laminated liners, with reinforced corners insures highest impulse withstand levels. It means, too, a heavier capacitor unit . . . because it's a better unit . . . but at no extra cost to you. How would you relate a slight increase in weight to years of trouble-free service?

Why is it that only C-D power capacitors give you assurance of complete dependability?... because C-D's built-in safety factor results from the ultimate in tried and proven design levels coupled with conservative production techniques and rigorous quality control. For catalog write to Cornell-Dubilier Electric Corporation, South Plainfield, N. J.



C-D's new semi-round pole mounting Contour Capacitor® Rack.



***This is an average based on reports from leading utilities using C-D capacitors. Many of these reports have shown 100% trouble-free service, and none lower than 98.9%.**

Tests Street-Light Relay

(*Continued from page* 172)

the relays, so that standard comparisons can be made.

While accurate light intensity is not needed for this purpose, it should be realized that the voltage change of battery, because of the condition of charge, will greatly affect the light output. The company uses a large lead-acid battery which is always on charge, except when being used for this purpose or checking mobile-radio equipment. Its voltage variation is small, but a voltmeter could be added to the board when deemed needed.

Blue cellophane and frosted glass are probably the most easily procurable materials for making the light filter. The 1-ft-c level was initially established as nearly as possible by a commercial ft-c meter and checked by testing several new photoelectric controls preset at the factory.

Rechecking in the same manner is done occasionally. The proper amount and color of blue to duplicate morning and evening daylight cannot be established without laboratory equipment. The number of blue cellophane filters were varied to give final intensity calibration.

The device is not a precise piece of laboratory equipment, but rather a small, easy-to-use tool that serves well for quick testing and final adjustments of photoelectric controls with sufficient accuracy and uniformity.

GENERATION—Maintenance

Tests Aided by Portable Stand

S. J. NELSON, Tidd Plant, Ohio Power Co, Brilliant, Ohio

A 10-ton dynamometer in a portable test stand solved for Tidd plant maintenance men the problem of testing lifting and pulling devices, such as chain falls and come-alongs.

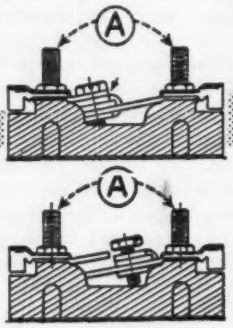
Formerly there was no way at this Ohio Power Co plant to measure the force needed to obtain rated capacities without overstressing the equipment. Visual inspections, not wholly satisfactory, were expensive, many man-

(*Continued on page* 178)

Here's How

STATES TYPE NT TERMINAL BLOCKS

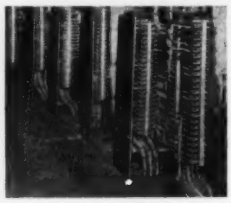
Allow Circuit Check Without Disturbing Permanent Wiring



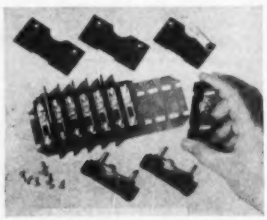
IT'S AS EASY AS A-B-C . . .

A. Just attach instrument to terminal posts.
B. Slide link out of contact—take reading.
C. Slide link back and bolt in position . . . That's all!

States Type NT Terminal Blocks are engineered for quick, safe, economical circuit checking. They're built in any number of poles desired, front or back connected, with or without coding strip, with or without cover.



Here's how one prominent utility uses STATES NT BLOCKS for panel circuits. Note incoming leads to terminal block from floor.



Above show how individual units are mounted on metal strips cut from 65 pole lengths. Thus "NT" Blocks may be obtained complete, or as parts to be assembled to fit any given installation.

THE STATES COMPANY
Specialists in Terminal Blocks
New Hartford, Conn.

19 New Park Ave.
Hartford, Conn.

I am interested in Terminal Blocks. Please send me Cat. No. 1, Sec. 6E.

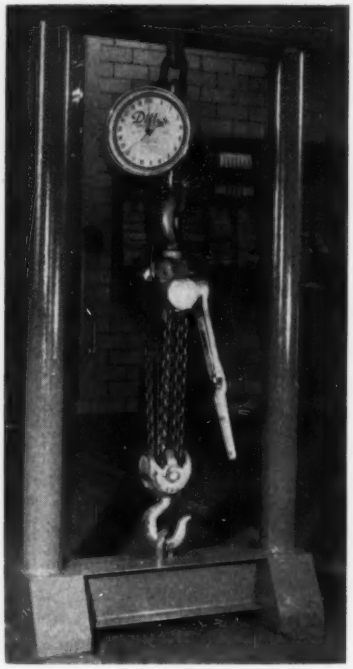
Name .....Title .....
Company .....
Street Address .....
City .....Zone....State .....

Stand Is Portable

(*Continued from page* 177)

hours being frequently required to dismantle the pulling device. To meet the need, the dynamometer was purchased and its stand constructed.

The stand was designed to with-



stand a load sufficiently in excess of 10 tons to afford a good safety factor and accommodate any lifting equipment rated up to 10 tons. Inside dimensions are 5 ft x 23 in. The top and bottom of the frame consist of two 6 x 32-in. I-beams welded together with ¼-in. plate between them. The 5-ft columns are 4-in. schedule 80 pipe, and the base ¼ x ½-in. plate. U-bolts (1-in. dia) for hooks run through the top and bottom I-beams. The nuts have ¼-in. bearing plates.

The dynamometer cost $287, and the testing stand $85, including material and 24 man-hours labor. The testing stand, set up in the machine shop, is used in practice sessions with different lifting or pulling devices in the frame, so that the men get the feel of various devices at rated capacity.

The next step will be to test wire-rope slings within its capacity.

(*More How To on page* 183)

WHO

PITCHES WINNERS IN COVERED CONDUCTOR?

In the dynamic electric power industry engineers and executives prefer Electrical World 4 to 1 . . .*

* Year after year, advertisers (and their agencies) survey their best customers and prospects: **"What one publication is most useful to you?"** Almost without exception the preference for Electrical World runs 4 to 1, or better.

PICTURE OF A KILLER.....STILL AT LARGE IN EVERY THUNDERSTORM

*TC

Here is the brief instant of supreme trial for an insulator -- when all the voltage stresses of lightning are built-up and not yet relieved. This is what insulators look like 1/100 millionth of a second before lightning flashover!

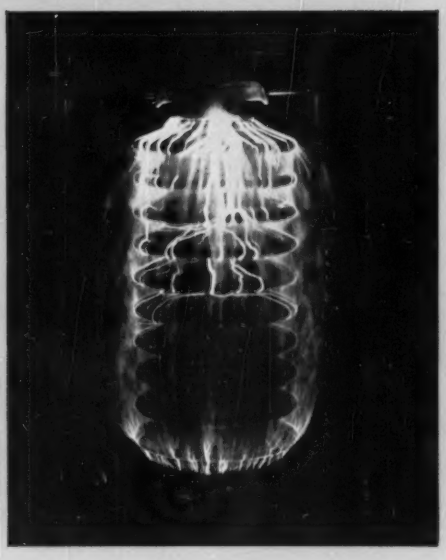
In all probability, the pictures on this and the next two pages, recently made in the O-B High Voltage Laboratory, are the first graphic recordings ever obtained of fractional-microsecond pre-flashover corona on a comparative series of conventional 69-kv insulators, under lightning wave-front conditions.

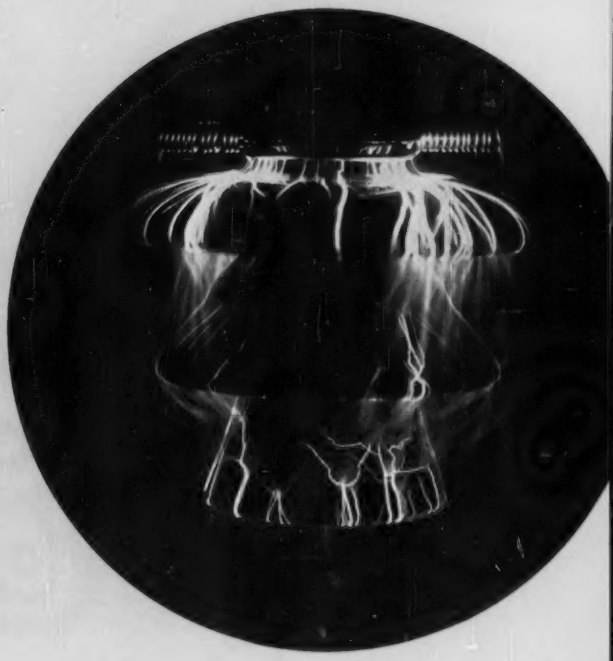
PLEASE TURN THE PAGE FOR MORE OF THE STORY

OHIO BRASS COMPANY, MANSFIELD, OHIO
In Canada—Canadian Ohio Brass Co., Ltd., Niagara Falls, Ont.

*TECHNICAL COMPETENCE the heart of every Ohio Brass insulator

When a Mere 1/100 Separates the MEN





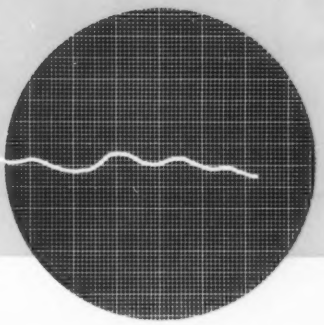
DATA ON THESE TESTS: In the O-B High Voltage Laboratory, great strides have been made in the routine attainment and measurement of ultra-steep-front impulse discharges. On these specimens the wave front was rising at a rate of 8,000,000 volts per millionth of a second (8,000 kv per microsecond). This is in the order of twice the rate of rise normally expected from natural lightning.

In order to eliminate the brilliant discharge and observe fractional-microsecond pre-flashover corona, a parallel rod gap was connected in the circuit and adjusted to fire at approximately 95 per cent of flashover voltage on the specimen. In no case did flashover occur in any of the accompanying illustrations.

From data on wave front and rod gap setting, it is estimated that the conditions depicted here exist 1/100 millionth of a second, or less, before flashover relief, at that instant when the insulator is exposed to maximum electrical stress.

* TECHNICAL COMPETENCE the heart of every Ohio Brass insulator

Millionth of a Second from the BOYS

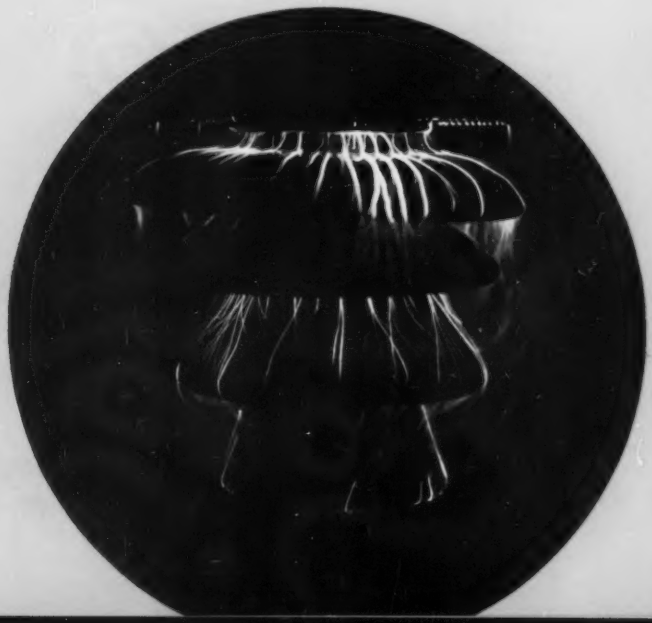


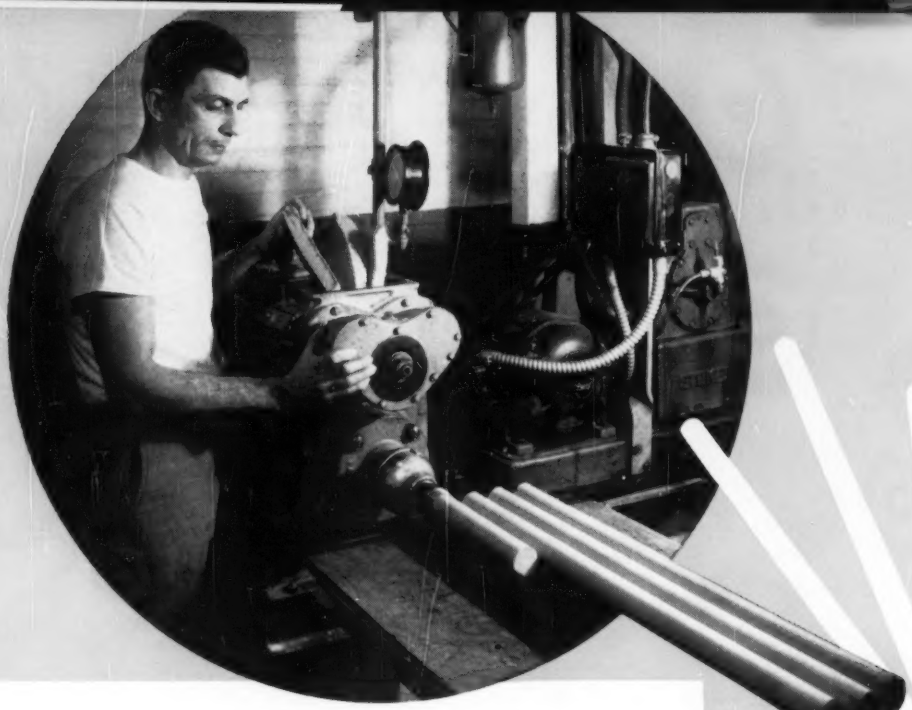
We don't want to disturb your sleep on a stormy night, but did you ever see what your insulators look like when lightning hits? Here is the unimaginably brief period of 1/100 millionth of a second when electrical stresses are at their maximum immediately preceding flashover relief. Here is the time in the history of insulators "when the men are separated from the boys"!

So -- we have finally attained test waves even faster than most natural lightning -- we have finally made them perform in front of a camera -- and we can relate all this to field performance. But what is back of it?

Laboratory procedures such as this are somewhat fabulous in terms of equipment and the quality of manpower. We needn't have this laboratory. We needn't explore these technical frontiers. We needn't do these things, that is, unless we are dedicated to making the best insulator that advanced research can produce.

*TC





We PAY this man to get into trouble

Clay, ready to make into insulators, is sometimes mighty contrary stuff. It "remembers" the screw that expelled it from the Pug Mill and tends to crack in that form when drying. Its loss of volume varies considerably in different directions while drying, followed with additional shrinkage during firing.

Handling the stock, called "pugs," is a tricky business. New products often pose a whole set of new problems. A factory can't work this way.

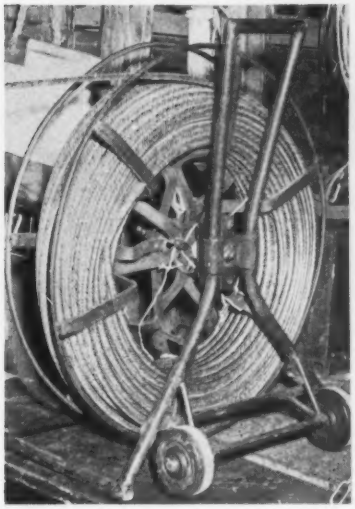
But, O-B has a rather unique answer -- the Experimental Pilot Plant -- where all operations are performed in miniature. Getting into trouble is their business; likewise getting out of it! When problems go to the factory, they're *solved problems.* When products come out of that factory, they're *good products.*

This is just one of many practical applications of Technical Competence, the heart of every Ohio Brass insulator.

OHIO BRASS COMPANY, MANSFIELD, OHIO
In Canada—Canadian Ohio Brass Co., Ltd., Niagara Falls, Ont.

4655-H

* TECHNICAL COMPETENCE the heart of every Ohio Brass insulator



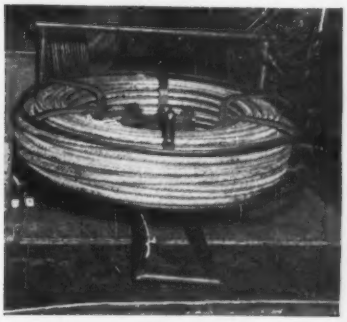
WHEELS make it easy to move cable reel to any place it may be needed

Demountable Reel Proves Saver

Consumers Public Power District has designed and built a portable demountable reel on wheels for handling armored aluminum service cable. The reel can be left in the service truck while in use, thus saving time in running services, and it saves service cable by facilitating the cutting of proper lengths during the installation of such services.

The reel protects the cable from damage in transit. Mounted on wheels, it is easily moved about. These reels have proved so successful that more of them are being made up by CPPD for use in 70 of Nebraska's 93 counties where it serves more than 100,000 electric customers.

REEL is built to lay in horizontal position, or to stand vertically



MR. DISTRIBUTION ENGINEER:

WHAT DO YOU KNOW ABOUT RT&E?

As one of the important men who distribute power to America, you should know something about one of America's leading suppliers of power equipment.

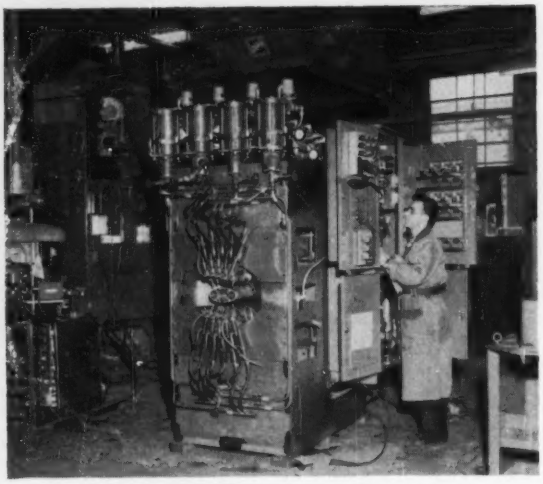
While we are not the largest transformer builder, you should know that we are one of the most reliable. Since economical performance and dependability are what *you* require, you will be interested in knowing that our transformers have been laboratory and field-tested and proved to meet every requirement of rugged service.

To back up what we say, our transformers are guaranteed for five full years of service. Our losses have been reduced to increase efficiency, improve regulation and raise overload capacity. Our externally operated tap changer is standard equipment at no extra cost.

These and other exclusive features have been developed from your suggestions. RT&E makes transformers the way *you* want them made.

RT&E CORPORATION
WAUKESHA, WISCONSIN
Equipment to help provide power for America

13.2-KV POLE LINE feeds 1,000-kva, 1-phase service transformer. The concentric conductor carries 480 v to the test area



ELBOW DROPS CONDUCTOR to spst switch, breaker in cubicle at left rear. Typical welder is on the test floor

Low Impedance Service for Resistance Welder

ERIC O'HARA, Industrial Div, Electric Sales Dept, Cincinnati Gas & Electric Co, Cincinnati, Ohio

A new, low impedance electrical service which will supply very high, instantaneous surges of power without disturbing other customers' supplies is now in use at the Precision Welder & Machine Co, Cincinnati. The service is used both in evaluating new developmental welders in the laboratories and in production tests of the resistance welding machines made by the company.

The operation of these machines is characterized by brief, instantaneous jumps in power consumption, which may run as high as 2,000 kva. In conventional service circuits the impedance is too high to provide sufficient power for proper operation of the welding machines without causing an irritating flicker in the equipment of other customers served by the same substation. As Precision has a relatively low motor load, there is not enough rotating machinery in the plant to provide any substantial assistance in reducing flicker.

New site, new service

In selecting a site for its new manufacturing plant, the company tried to find a location as close as possible to one of Cincinnati Gas & Electric's larger substations, to minimize the cost of obtaining a low impedance service. Together, CG&E and Precision were able to find a location within a mile of one. CG&E constructed a 13.2-kv, 3-phase overhead pole line to provide a service impedance at the substation of (16.8 + j39.2)% at 100,000 kva. The service transformer is rated 1000 kva, 13,200/480 v, single phase, with a 1.9% impedance.

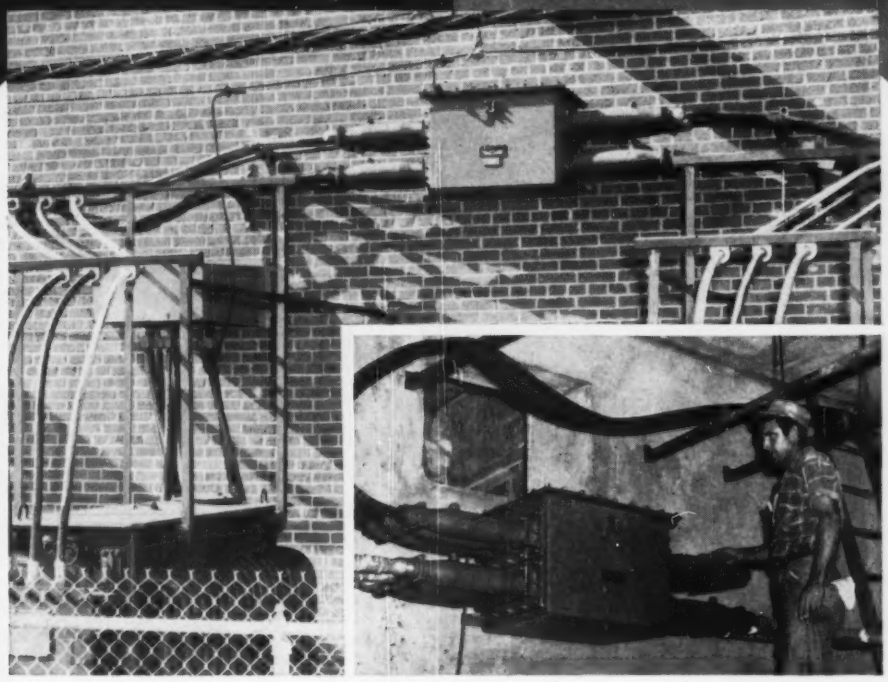
With this portion of the problem solved, the chief remaining task was to determine the proper design for the circuit from the service transformer to the point of use on the welder test floor. After a study of the April, 1952, A.I.E.E. report entitled "Power Supply for Resistance Welding Machines," it was apparent that a concentric conductor, with very simple construction, offered the lowest impedance.

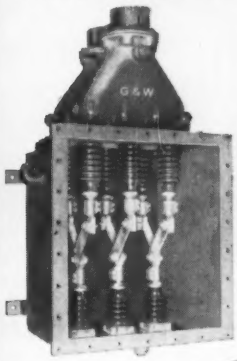
The conductor, as finally constructed, used a 3-in. copper tube (extra heavy iron pipe size) as an inner conductor and a 4-in. copper tube (standard iron pipe size) as the outer conductor, with melamine impregnated fibre glass as insulation between the two. The concentric circuit is approximately 40 ft long.

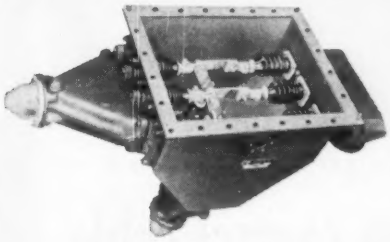
At 480 v, the voltage drop in this circuit is estimated to be 0.06% per 1,000 amp, with a 30% power factor. After the new installation had been completed, CG&E drew up a new set of limitations, based on the standard flicker curve, to prevent disturbance to other customers:

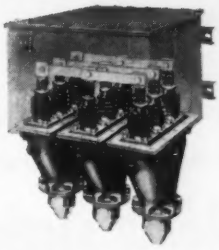
Frequency of Welds	Allowable Instantaneous Kva
10 per sec	350
10 per min	1050
10 per hr	2220

SPECIALLY DESIGNED CONDUCTOR uses two sizes of copper tubing, impregnated fibre glass insulation between

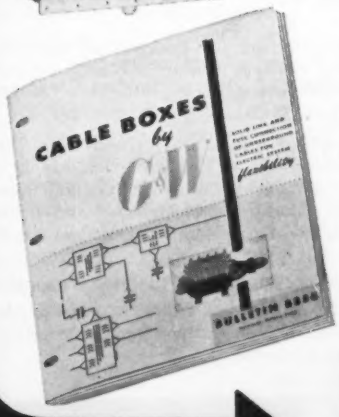








G&W TYPE "OL" OIL FILLED LINK BOXES



may be just what you need—for interconnecting high voltage cables that require infrequent sectionalizing at no voltage.

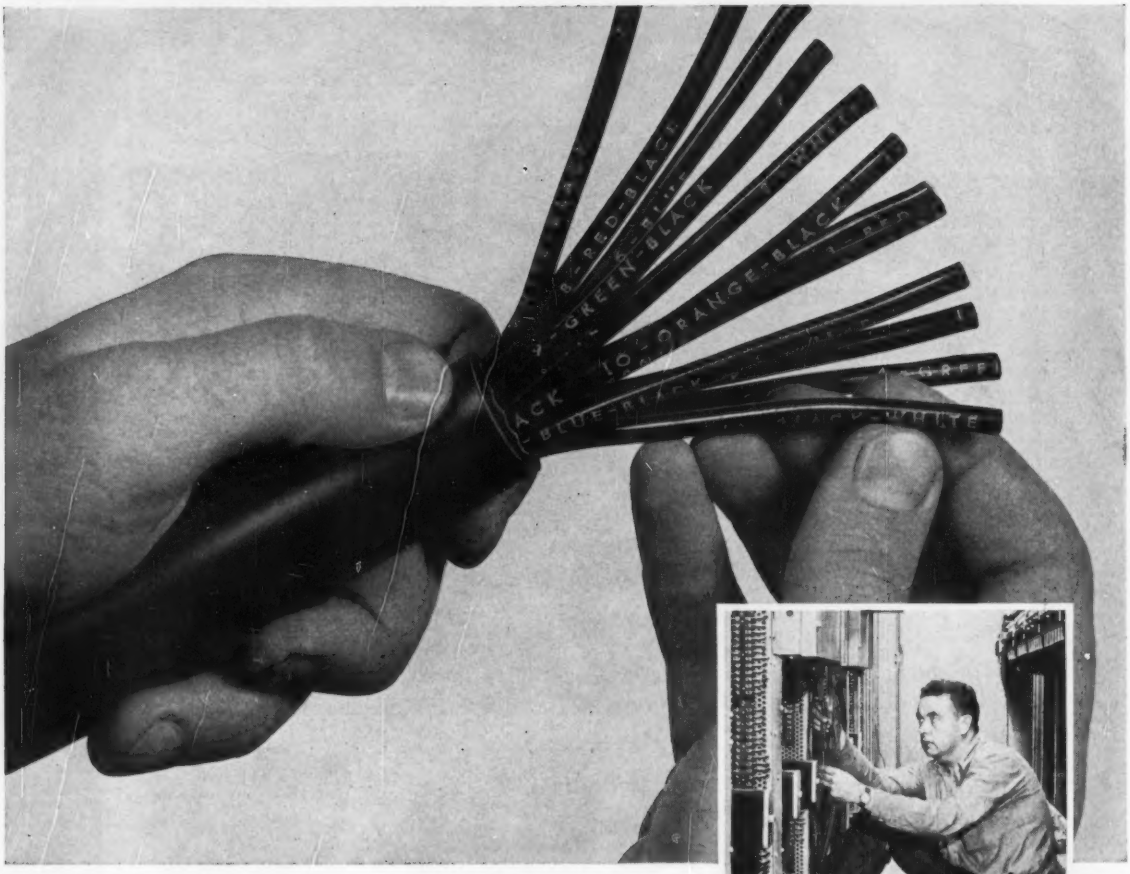
Cableheads are compound filled unit sealed potheads with copper links between capnut lugs. Cable entrances are wiping sleeve or stuffing box. Boxes are welded steel, with Resistoyl gasketed lids and flanges—oil filled for minimum size. (Larger Type "AL" air filled boxes are also available.) Voltage ratings—7.5 and 15 Kv (standard) and up to 34.5 Kv (special).

Send for Bulletin BB55, a comprehensive listing of various types of link, fuse and splice boxes.

G&W ELECTRIC SPECIALTY CO.
7780 Dante Avenue, Chicago 19, Illinois

Representatives in principal cities of U.S.A.
Canadian Mfrs.—Powerlite Devices, Ltd., Toronto, Montreal & Vancouver

B561



Color-coded and numbered every 1½"

New Rome station control cable assures quick and positive circuit identification

You can reduce installation expenses and the cost of routine maintenance by specifying Rome control cable (CRO-1) for your next job. Rome's new surface-printed color coding makes it much easier to quickly identify control circuits, even when light is poor or when handling has dirtied conductor coverings. Every conductor is color-coded and numbered *on both sides* at intervals of 1½" or less, and permanently clear white lettering provides maximum legibility.

Three different types of Rome control cable are available:

RoZone insulated—RoPrene sheathed • This is the ultimate in control cable design and performance. Conductors are insulated with RoZone, a high-quality oil-base compound and each conductor is individually sheathed with RoPrene (Neoprene). A RoPrene jacket provides over-all protection. Ask for Type CRO-1.

RoMarine insulated—RoPrene sheathed • This is a more moderately priced, high-quality, general purpose design. Individual conductors are insulated with a heat- and moisture-resistant synthetic rubber compound, and the over-all jacket is RoPrene (Neoprene). Specify Type CRM-1.

Rome Synthinol insulated—Rome Synthinol or RoLene sheathed • This cable features a quality thermoplastic construction with Synthinol insulation (polyvinyl chloride) protected by a Synthinol or RoLene jacket. A small diameter moderate cost control cable, this is our Type CT-2.

SPECIFY ROME STATION CONTROL CABLES FOR YOUR NEXT JOB. And if you would like more information on this product, contact your nearby Rome Cable Sales Office. Or write to Department 800.

It costs less to buy the best

ROME CABLE Corporation
ROME • NEW YORK
and
TORRANCE • CALIFORNIA

Electric Furnaces Hike Efficiency

JAMES R. WARK, Power Sales Engineer, Indianapolis Power & Light Co, Indianapolis, Ind.

Electric furnaces are helping Howe Engineering Co, Indianapolis, Ind., achieve maximum effectiveness and efficiency in a new plant producing non-ferrous castings and electrical fittings for locomotives.

The manufacturer sought to attain in the new plant a maximum production efficiency. He also wanted good flexibility and operating economy. But several types of furnaces could have been used for the gravity-type die-casting operation involved.

The manufacturer was shown how to use a formula derived by the Machinery Products Institute for determining the most advantageous type of equipment to apply to a particular heating process.

Furthermore it was pointed out that some of the benefits of electrical process heating are not easily measured in terms of dollars and cents. These benefits include: Accurate temperature control, increased comfort for employees operating the furnace, and economical holding of the melt overnight and on weekends.

After considering the various aspects, the manufacturer chose electric furnaces. He already has installed three 40-kw resistance-type holding furnaces which are ideal for their hand loading of aluminum. Induction melting furnaces are being considered to attain maximum economy with a completely integrated all-electric operation. Purchase of a 90-kw induction-type brass melting furnace is a distinct possibility for further expansion in the future.

INDUSTRIAL NEWS NOTES

Features New Pumps

The new sewage pumping system at Camden, N. J., has four 30-in. mix flow vertical pumps at the main pumping station. Three 16-in. pumps will be put in operation at Arch Street station soon, according to Worthington Corp. Five pumps, with magnetic variable-speed drives constitute what is probably the first installation with a new automatic recycling float control.

When minimum level is reached, the first pump starts at minimum speed and capacity. As flow increases, it gains speed and capacity up to the flow level. A recycling device brings in the second pump similarly and reduces the first pump's speed. Both then divide the flow, increasing speed evenly as flow increases, keeping a predetermined level. Additional pumps are brought in as needed. As flow decreases, each pump loses speed and capacity.

•

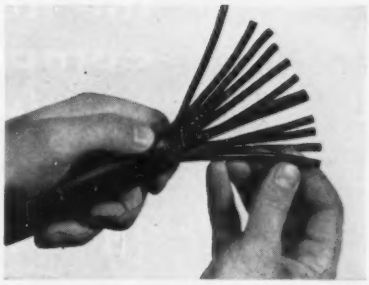
New Furnace for Sharon Steel

Sharon Steel Corp has announced that it will construct a $6-million electric furnace facility at its Roemer Works, Farrell, Pa. This expansion will double the company's capacity for the production of stainless and high alloy steel. Construction of the facility, a step in a major improvement and expansion program now being carried out by Sharon Steel, will allow for the addition of a second furnace. The unit is scheduled to be in operation by January 1958.

•

New Triode For Industrial R-F

A new power triode which will deliver 6 kw at frequencies up to 50 Mc has been developed by Mullard, Ltd, of London, Eng. The new tube, the TY7-6000, is intended for use in industrial r-f generators. The triode has been conservatively rated to insure adequate margins of safety in industrial heating applications where it may be subjected to intermittent overloads resulting from circuits and load variations. The tube is available in two versions, the TY7-6000 W, a water-cooled model, and the TY7-6000 A, designed for forced air cooling. Maximum permissible plate dissipation for either model is 6,000 w. Plate voltages as high as 7 kv may be used. The tubes have a cap-type plate connection and directly heated, thoriated tungsten filaments.



New Rome Station Control Cables

Can be ordered from any one of the following sales offices:

ROME CABLE SALES OFFICES

*ATLANTA 13, GA.
156 Simpson St., N.W.
MUrray 8-9860

BOSTON 10, MASS.
Chamber of Commerce Bldg.
80 Federal St.
HAncock 6-7272

*CHICAGO 39, ILL.
4505 West Grand Ave.
SPaulding 2-2700

CLEVELAND 14, OHIO
Society for Savings Bldg.
145 Public Square
SUperior 1-1240

*DALLAS 26, TEXAS
3015 Taylor St.
PRospect 4801

*DENVER 4, COLO.
1160 Elati St.
KEystone 4-0533

DETROIT 2, MICH.
547 New Center Bldg.
TRinity 2-7578

*HOUSTON 2, TEXAS
240 Shea Place
FAirfax 3-8385

KANSAS CITY 11, MO.
406 West 34th St.
JEfferson 1-4146

*LOS ANGELES 22, CALIF.
2510 South Malt Ave.
RAymond 3-3631

NEW YORK 17, N. Y.
60 East 42nd St.
MUrray Hill 2-6590

PHILADELPHIA 7, PA.
12 South Twelfth St.
MArket 7-2070

PITTSBURGH 22, PA.
1001 Oliver Bldg.
ATlantic 1-0816

ST. LOUIS 17, MO.
6617 Clayton Rd.
VOlunteer 3-4944

*ST. PAUL 4, MINN.
345 N. Wheeler Ave.
Midway 6-7201

*SALT LAKE CITY 1, UTAH
230 South Fourth West St.
ELgin 9-8811

*SAN FRANCISCO 24, CALIF.
1100 Selby St.
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Superformed
LINE CONDUCTOR
ACCESSORIES

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This new FANNER Catalog illustrates and describes the wide range of Superformed Line Conductor Accessories . . . gives selection tables, application data and suggested installation methods. Get acquainted with this catalog now so that when you need accessory items for overhead distribution and transmission lines, you can take advantage of the many extra features of Fine FANNER Superformed products. Each product in the FANNER Superformed line is precision manufactured to install easier and perform better on the job. Careful packing insures safe delivery and simplified storage. Highest quality materials provide long life regardless of the type of installation. With all their extra features, FANNER Superformed products cost no more than ordinary products.

For the latest data on line conductor accessories — information that will be of exceptional value to you, write for the new FANNER Catalog EP6 today!

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THE FANNER MANUFACTURING CO.
Electrical Products Division
Brookside Park • *Established 1894* • Cleveland 9, Ohio

AGENTS AND DISTRIBUTORS IN PRINCIPAL CITIES

INDUSTRIAL BRIEFS

Electrically heated intake and exhaust lines on a pneumatic lift have been used to insure year-round operation at Goodman Cinder Block Co, Honesdale, Pa. Before the installation was made, it was necessary to shut down production equipment frequently during cold weather to thaw out the block lift. By wrapping 180 ft of heating cable around the high pressure air lines and the exhaust tips and by adding an additional 800 w to the power load, winter shutdowns because of freezing have been eliminated, production has increased, and costs have been cut. Charles Millar, Industrial Sales Representative, Pennsylvania Power & Light Co, Wilkes-Barre, Pa.

Better employee working conditions resulted from the cleaner and safer electric heat after the Valley Dolomite Co, Bonne Terre, Mo., replaced oil circulating heaters with electric unit heaters in several plant offices. Even in colder weather, the unit heaters maintain a comfortable temperature. The 3.0-kw fan type heater used, heats an uninsulated office 7½ x 12 x 8 ft. Robert E. Enkelmann, Industrial Engineer, Union Electric Co, St. Louis, Mo.

A dielectric heating unit installed at the Kohler Plastic Co, Fenton, Mo., preheats plastic "pills" or "biscuits" before they are inserted in the compression molding press. Dielectric preheating reduces the pressure required and cuts curing time to speed up production. Robert E. Enkelmann, Industrial Engineer, Union Electric Co, St. Louis, Mo.

Even, economical office heating is assured by 19 kw of electric baseboard heating units at the Jones Metal Products Co, West Lafayette, Ohio. After mounting complaints of "too much" or "too little" heat from the office girls, the company finally decided to replace its old steam heating system with the easily regulated electrical units. Impressed by the ease of installation, minimum maintenance, economy, and dearth of complaints, the company also heats its washrooms electrically with radiant glass panels. D. A. Sauers, Industrial Power Engineer, Ohio Power Co, Coshocton, Ohio.

3 Legs Make Twice the Derrick

With Holan's three-legged derrick, you are ready for any job at a moment's notice... butt-pulling... body-loading... extra-heavy lifts.

The integral third leg means crews won't have to sit idle while a separate third leg is being attached. And the integral third leg gives extra strength to provide a wider and safer working range.

This derrick was designed to do more than it has to. It lifts loads up to 12,000 pounds, poles 75 feet long . . and has been load-tested at 22,000 pounds. For body loading, it hoists up to 5,000 pounds of equipment over the rear axle. Working range is 195° — the derrick head lowering to within five feet of the ground. Two levers at the rear of the truck body hydraulically control the derrick and live boom.

There's nothing else in the field like Holan's Series 3700 Live-boom Power Derrick.

Write for the Series 3700 catalog.

J.H. HOLAN CORPORATION

4100 WEST 150TH STREET
CLEVELAND 11, OHIO

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BRANTFORD-HOLAN LIMITED, Brantford, Ontario

THE NAME THAT MEANS WORK SIMPLIFICATION

Line construction bodies for light to heavy-duty. Crew compartments optional. Efficient tool compartments and drawers.

Bodies for truck driven air compressors. Designed to accommodate hose reels, tapping machines, jack hammers, etc.

Service bodies for chassis up to 1½ ton. Lengths, 72", 75", 84", 90" and 102".

Hydraulic Derricks designed for front or rear mounting. Capacities to 12,000 lbs.

Light-duty power operated derricks for front or rear mounting. Operating range of 146°.

Ladders to 40' with all phases completely hydraulic. Pump actuated by P.T.O. or separate engine drive with electric starter.

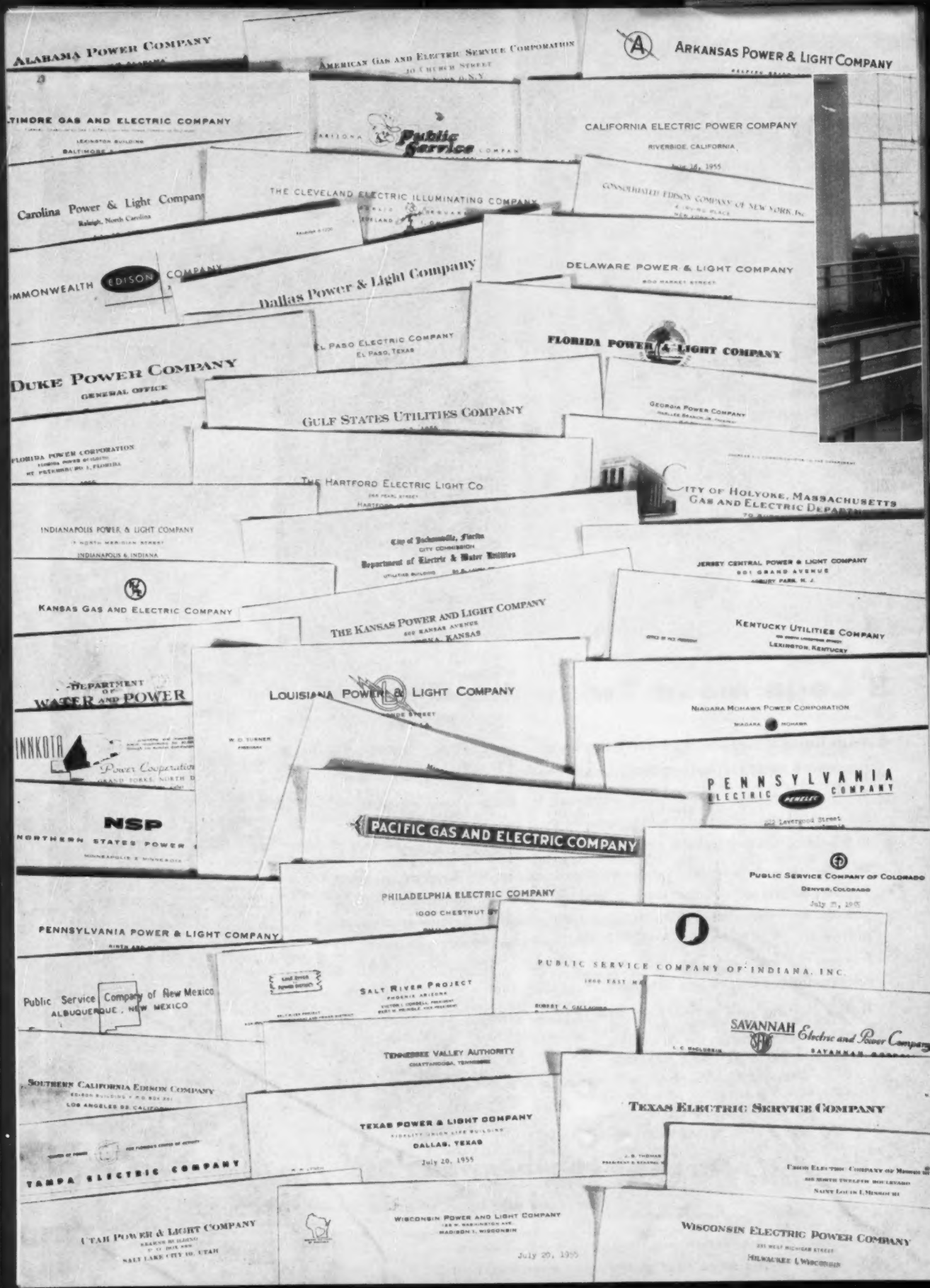
Mechanical Ladders expertly engineered and counterbalanced for effortless handling. Maximum heights from 23' to 40'. Swings 360°; angles to 72°.

Portable hydraulic and mechanical earth borers. Augers for 8" to 20" diameters, depth to 8'.

Wide variety of pole and reel trailers. Standard and special. Many optional features.

Hydraulic jacks, controlled from rear of truck. Rigid mounted or patented Holan self-stowing types.

Hydraulic towers with rotary, stationary, or transverse platforms. Exclusive box-girder telescoping mast.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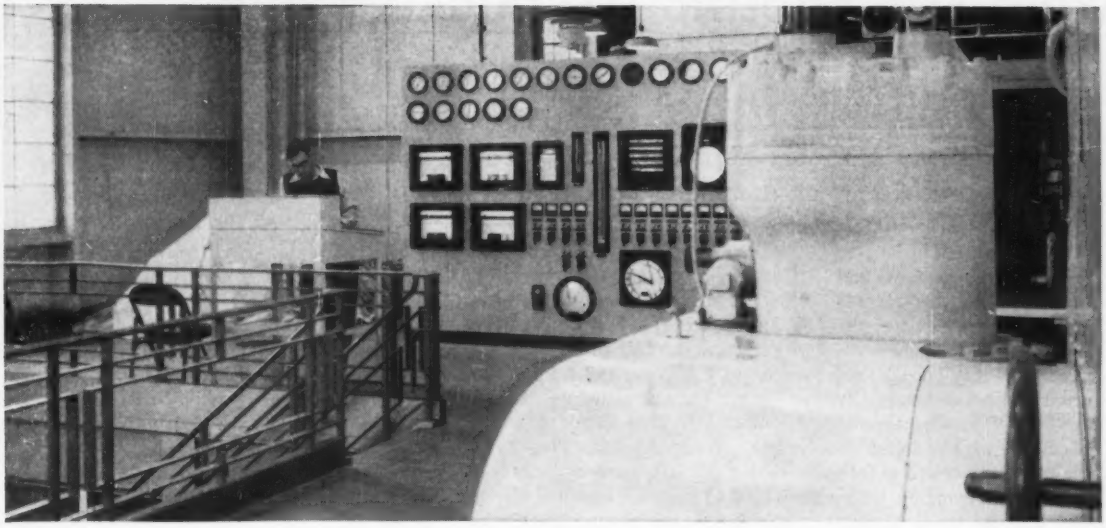


Typical installation of Honeywell supervisory instruments for a 60,000-kw turbo-generator at the Tyrone, Kentucky plant of Kentucky Utilities Company.

YOU'RE IN GOOD COMPANY

when you choose . . . Honeywell instrumentation

You join America's best-known public utilities when you choose instrumentation by Honeywell. You'll find Honeywell instrumentation everywhere . . . in large stations and small. The reasons for this are clear.

With the precision, stamina, and reliability of Honeywell instruments, you get an important extra . . . service. This service begins with your first plans, and continues long after your instruments are installed. It includes:

Application engineering of instrumentation, custom-fitted to your plant by a staff experienced in power station measurement and control.

Installation and startup assistance by Honeywell service engineers.

Maintenance engineering, in emergencies or on a periodic service schedule, by factory-trained specialists located near you . . . in the more than 112 Honeywell offices in the United States and Canada.

Quick shipment of spare parts, from your local Honeywell branch office or from the Parts Depot in Philadelphia.

Training of your instrument men in up-to-date maintenance at the tuition-free Honeywell Education and Training Center in Philadelphia.

These are but some of the benefits you gain when you add your company's name to the list of prominent companies using Honeywell instrumentation. Get the full story from your nearby Honeywell sales engineer. He's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

First in Controls

Rural Heating Looks Good

86% of co-ops survey see more desirable heating load factor by 1960; want offset to air conditioning and pumping

Can electric house heating help to improve the economics of farm and residential service in the years ahead?

Rural electric cooperatives over the country seem to think so. Some 86% of 135 surveyed said they felt the load factor for complete house heating by electricity will be more desirable in 1960. Their reasons: The influx of air conditioning and continued growth of summer irrigation pumping loads.

A healthy 112 of them already are serving 12,074 electrically heated homes. For the most part they seem ready to take on more. One large Kentucky cooperative says it now has more than 3,000 electric heating customers on its lines. Another in Oregon reports a 14% saturation among its 4,600 customers.

Survey was conducted earlier this year by the Electric House Heating Section of the National Electrical Equipment Manufacturers Assn. The 135 co-ops which responded together serve nearly 1 million meters.

Concern for summer peaks brought on by air conditioning was centered most strongly among co-ops in the Southern and Southwestern regions. Irrigation pumping was the principal factor on the West Coast and to a surprising degree in some areas further east.

Said a Virginia co-op manager: "Our cooperative, and I presume all others that serve strictly rural areas, is confronted with a peak occurring in the evening. Our peaks are from 4 a.m. to 7:30 a.m., and from 5 p.m. to 9 p.m. The rest of the way around the clock our load factor is down, yet we pay the demand. Therefore I welcome the heat load as I think it will tend to level our load and give us something that is around the clock."

A Pennsylvania manager thought rural areas offer electric house heating its greatest potential. "We think that it is conceivable that within a generation it will equal all of our other loads combined," he declared. "For each 100 kw of air conditioning load, we could profitably carry 200 kw of heat load," observed a Tennessee man.

To push its heating sales, a Texas co-op has adopted an "all-electric home rate" featuring a special low heating rate during the six winter months of the year. Observes another rural power distributor in Tennessee: "Our users are learning to use the 'locked thermostat' method of use. The higher density will also improve load factor."

Further north more varied opinions prevail. Most see electric house heating as a desirable load builder. "But," says a Minnesota manager, "electric heating without air conditioning will hurt us." There was a pronounced tendency to control heating by limiting voltage during peak hours among several of the cooperatives in the Midwest region.

Although the survey was confined to electric resistance heating, the heat pump also came in for mention by a sizable number of co-ops. "It's the coming thing for those desiring year-round air conditioning," states one. Another felt the heat pump will be in greater demand in his area than resistance heat, although he didn't say when.

At least 16% of the co-ops questioned have made studies of their heating loads—either of individual homes or their entire distribution systems. Some observations:

- Annual load factor will average 12% to 14% with the modal average ranging between 11% and 16%. However, the range of annual load factor between individual homes is wide—from below 10% to over 18%."—Tennessee.
- "House heating actually increases monthly load factor."—Oregon.
- "Diversity about 75% to 80%." —Ohio.
- "Thirty-five per cent load factor monthly. Heat lowers system load factor approximately 7%."—Tennessee co-op serving 250 heating customers.
- "Study of 600-unit housing project over three years shows annual load factor ranging from 25% to 28%."—Tennessee co-op.

HEATING AND COOLING BRIEFS

Central Air Conditioning—$900

Waterless central air conditioning units for homes, list priced at around $900 have been announced by Westinghouse Electric Corp. They are available in 2, 3, and 5-ton sizes.

Heating Goes to Dogs

The Cloverleaf Dog Track, a parimutuel betting track near Loveland, Colo., north of Denver, has installed 18 electric heaters in the grand stand for the comfort of bettors during the fall racing season. Fifteen heaters are 10 kw and three of them are 5 kw. Public Service Company of Colorado reports the heaters consume as much electricity in an hour as the average residence uses in a month.

H&C Quickies

Heating pad for baby's play pen and an under-the-rug pad are new Radiant Products, Inc, items. . . . Portable foot warmer designed for offices, production lines has been introduced by Interstate Rubber Products Corp . . . A 2-kw glass radiant heater with greater concentration of wattage per square inch is recent Berko Electric Mfg Corp development. . . . A bar for towel or hosiery drying is on 625-w radiant glass heating unit designed for bathrooms by Continental Radiant Glass Heating Corp.

Appliance 'Side Choosing' Seen

Westinghouse Electric Corp, with 20 to 30% of its 13,000 major appliance dealers selling 80% of its volume, says dealers are swinging to handling one line exclusively.

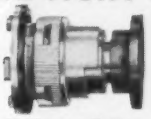
Square D FOR THE MOST COMPLETE line of Oil-Tight

PUSHBUTTONS

Square D pushbuttons, designed to JIC and NMTBA standards, have been proven by severe tests involving millions of operations. They offer still other features... generous wiring space and exclusive *"Slide and Swing"* enclosure covers for easier, faster installations when machine operations are changed.

OIL-TIGHT OPERATORS

Momentary Contact Guarded button in 7 colors.



Mushroom Button 1⅛" or 2¼". Momentary contact. 7 different colors.

Selector Switch 2 or 3 position with 4 different cams.

Coin-operated Selector Switch Available in same selection as standard type.

Key-operated Selector Switch Discourages unauthorized operation.

Selector Pushbutton combines selector switch and pushbutton. 2 or 3 position.

Padlock Attachment Latch type. For momentary contact buttons. Locks "OFF" position.

Padlock Attachment Cover type. Prevents depressing button.

Maintained Contact Attachment Used with 2 operators, 1 contact block.

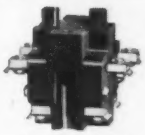
Selector Switch Lockout Permits switch to be locked in any one of three positions.

Wobble Stick Operator for momentary pushbutton operator. Ideal for emergency stop with pendant station.

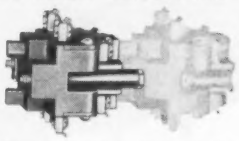
Neoprene Cap for momentary contact button. Prevents liquids, dust and grit from working into pushbutton operator.

CONTACT BLOCKS and PILOT LIGHTS

Single Pole N.O. and N.C. Contacts



Duplex N.O. and N. C. Contacts



Tandem Operation. Duplex N.O. and N.C. Contacts with extended stems for combination with another block.

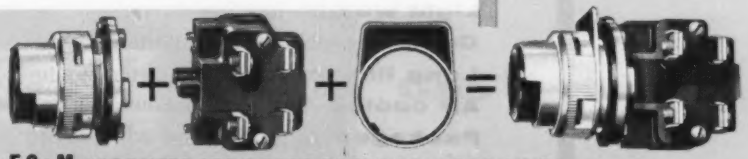
Duplex N.O. and N.C. Contacts with one N.O. circuit closing ahead of the other. Designed for 2-speed or sequence operations.

PILOT LIGHT • Generous illumination and wide-angle visibility. Greatly reduced filament burn-outs. No loosening of lamp under vibration. Six colors—red, amber, green, blue, white, clear.

You'll like the *completeness* of Square D's pushbutton line. Every conceivable combination can be obtained with a minimum stock of packaged units. Enclosures available for 1 to 16 units.

Write for Pushbutton Bulletins which give complete details. Address Square D Company, 4041 North Richards St., Milwaukee 12, Wisconsin.

ANY OPERATOR WITH ANY CONTACT BLOCK



NOW...EC&M PRODUCTS ARE A PART OF THE SQUARE D LINE!

SQUARE D COMPANY

Now to supply **both** Power

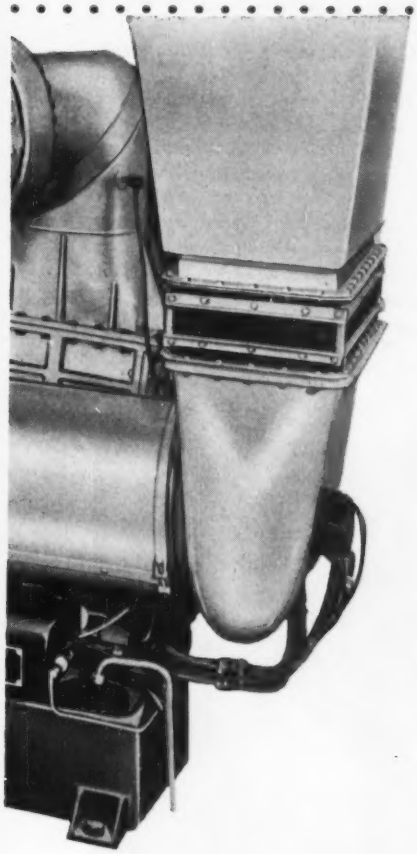
Clark introduces

Mark TA Features

Quick starting—2 minutes to full load
Quick shutdown—instantaneous—no turning gear
Field proved—forty units delivered
Light weight—less than 6 tons
Compact—only 16′ long, portable
Long life—conservative blade temperatures
Air cooled—long life—cool outer surface
Packaged—shipped assembled, ready to install
Fuel versatility—liquid or gaseous
Installation flexibility—up or down duct connections
Variable speed—physically separated turbines
Single combustion chamber—lasts a lifetime

and **Steam**

the **Mark TA** Gas Turbine



Power to drive a generator, pump or centrifugal compressor and low or high pressure steam for process use . . . the new Clark Mark TA 1130 bhp gas turbine will do both when equipped with a waste heat boiler. In addition to the 1130 bhp of rotative energy the turbine-boiler package will deliver 9500 lbs. of steam per hour at a combined fuel utilization of up to 79%. It's the most modern, compact and efficient power plant combination you can install!

The new turbine is also well suited to driving rotative loads without a waste heat recovery system. Its light weight, compactness and quiet, practically vibrationless operation makes it ideal for marine or portable use as well as for permanent installation.

Your nearest Clark representative will be pleased to give you all the facts about Clark gas turbines in sizes to 8500 bhp, or write for bulletin 142.

CLARK BROS. CO. OLEAN, NEW YORK

One of the Dresser Industries

Offices in Principal Cities Throughout the World

CLARK® ONE OF THE DRESSER INDUSTRIES

Gas Turbines

Teach Contractors How to Sell

Utilities ready Housepower Forums on Residential Wiring to show profits. NCEA and EEI cooperate in program plans

The old problem of getting the contractor to sell wiring may be headed for a new solution this month.

Electric utilities are readying Housepower Forums on Residential Wiring in their areas to show contractors how to build their home wiring business. The forums—actually a series of six meetings—have been produced by Edison Electric Institute in cooperation with National Electrical Contractors Association as part of its overall Housepower program. Present plans call for either six 2-hr meetings or three 3-hr meetings to be sponsored by the local utility. The choice and the enrollment fee to be charged the contractor are left to the utility's discretion.

The program makes heavy use of visual sales methods and group discussion techniques, says Porter Henry & Co, which developed it. Cost of the forum's "package" of materials is $250. It includes:

1. A detailed Planning Guide.

2. Conference Leader's Manual which explains the how's and what's of setting up and conducting the meetings.

3. Audio-visual materials including three slide film presentations.

4. Take-home booklets, bound in a special binder for the contractor's own use. Twenty booklets are included in each forum package purchased.

5. Housepower visual sales presentation, a tailor-made sales pitch the contractor can use to explain specific benefits to prospects.

A test run of the forum's pulling power already has brought a hearty response from three Philadelphia contractors, says EEI. Using their visual presentations after one week's training, all three reported a sale for every contact they made. One gave his pitch at a neighborhood party. The result: four guests, four sales.

The forum meetings, says Porter Henry, cover these sales areas: The market and the contractor's basic selling strategy, how the contractor can make his prospect want "full Housepower," how the contractor can achieve faster selling through sales tools, how he can overcome objections, how he can make each job profitable by selling quality. The final meeting discusses ten ways the contractor can reach prospects.

Two preliminary Housepower meetings were held last month in New York and Chicago to brief utility instructors who will conduct local forums. Wayne University in Detroit plans to offer the forum as part of its regular extension courses this year.

Forum kit may be ordered from Housepower Program Manager, Edison Electric Institute, 420 Lexington Ave, New York 17, N. Y.

KP&L Rewards Employees Who Pitch Housepower

In another kind of Housepower contest, Kansas Power & Light Co is giving a 14-cu ft food freezer to the employee who got the most KP&L customers to enter the $100,000 national competition. Two runners-up get electric range and dishwasher. Top employees in each KP&L division also receive prizes—portable radio and electric fry pan to first and second place winners.

Lee Nicholson, KP&L's director of new business, feels this type of contest works better than one patterned after the national competition because:

1. Employee's word of mouth advertising will stimulate more customer participation.

2. Employee will have to be familiar with the national contest and the facts of good wiring in order to aid the customer.

3. No judges are necessary.

(*More S & S on page* 198)

School Teachers Get AW Training

Teaching the teachers is consistent part of Northern States Power Co's Adequate Wiring program. R. J. Graf, supervisor of NSP's Builders Sales Section, here addresses an organization of industrial arts teachers in the Minneapolis school system. He stresses such points as what is meant by adequate wiring, the need for adequate wiring, and demonstrations of new types of switches and other household wiring equipment. Similar talks are made before industrial education students at University of Minnesota, to home economists attending the university's annual short course, and to teachers attending Business-Education Day sessions at NSP division headquarters cities.

Now... Talk through noise

NEW TRANSISTORIZED **POWER VOICE** speaker

The secret is in the exclusive **"GOLDEN HEART"** *transistor*

Hear your mobile radio

HUNDREDS OF FEET AWAY

Now your vehicles, in fact any mobile radio equipped vehicle, can get far greater volume than ever before, with the new Motorola transistorized Power Voice Speaker.

This new compact, inexpensive speaker-amplifier combination delivers 10 TIMES MORE POWER than the conventional passive speaker. No more straining to hear messages. Just turn it up—it's got all the volume you'll *ever* need, all in this one small package. No longer is your driver shackled inside his vehicle...he can move about freely, hundreds of feet away, and still hear his dispatcher.

Secret of Motorola's newest development is the built-in transistorized amplifier, utilizing two long-life, Motorola power transistors. With the average 12 volt mobile radio system, the new speaker develops *15 watts* audio output. Even on a 6 volt system, you get 5 watts output—*much* more than the conventional one watt speaker level.

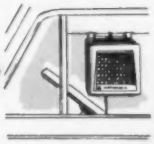
This power packed speaker is available for your mobile 2-way radio NOW. It can be quickly and easily added to most 6 or 12 volt installations. With the new Power Voice Speakers doing a bigger, better job for you, you'll also find low battery drain, bandpass response that accents voice frequencies, and versatile Quick-detach mounting...in a compact, all-metal housing.

You must *hear* the new Power Voice Speaker to appreciate what this added power can mean to you. Write, phone or wire today...or mail the coupon below.

New POWER VOICE speaker mounts firmly under dash in same familiar position

BUT...

detaches in a second to be hung from vehicle window and may be heard clearly hundreds of feet away.



MOTOROLA... always FIRST with the NEWEST in TRANSISTORIZED EQUIPMENT

MOTOROLA
2-WAY RADIO

MAIL THIS COUPON FOR LITERATURE
or a demonstration

Motorola Communications & Electronics, Inc., Dept. 16
4501 Augusta Blvd., Chicago 51, Ill.

☐ Please send me more information on the new Power Voice Speaker.

☐ I want to hear a demonstration of the Power Voice Speaker.

NAME_____ TITLE_____

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Two New Minerallac Quality Products
Designed for Jobs Too Heavy for
Standard Jiffy Clips

MINERALLAC
Heavy Duty AND Medium
JIFFY CLIPS

Also available without mounting hole for use with gun.

patent pending

Made of heavier materials! Has exclusive inverted rib, that provides more strength at the bend of clip . . . and, of course, adds the benefits of famous "Snap On" feature!

In stock in Zinc-Plated Steel for Thin Wall or Rigid Conduit up to 6". (Hot Dipped Galvanized may be obtained on order) Can be substituted for malleable clips.

Order From Your Electrical Wholesaler

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MINERALLAC ELECTRIC COMPANY
25 North Peoria St. Chicago 7, Ill.

MINERALLAC

WHO
CAN COACH YOU BEST
IN
COVERED CONDUCTOR?

'Kitchen Fun' Lures Boys to Cookery

Boys in cooking classes? You bet! And they eat it up, reports Arizona Public Service Co, which has sponsored summer cooking courses at Phoenix Boys Club. Emphasis on informality and "kitchen fun" theme found the lads taking time from swimming and craft classes for rapt attention to studying art of cooking.

Boys make intelligent, eager students, the utility's home economists declare. Said Gretchen McIlwain (above): "By approaching instruction from the standpoint of mechanics, they become extremely interested and stay right with the course."

Electric Heat Helps Processing of Beeswax

DON JORDIN, Farm Representative, Washington Water Power Co, Spokane, Wash.

Electric heat and power make honey and beeswax handling easier, faster for Arthur D. Rice, Liberty Lake, Wash. His apiary has 3.5 kw of equipment in the extracting house, which processed about 50,000 lb of honey and 500 lb of wax from 500 hives in 1955.

During the honey harvest, the extraction room must be kept at 85-90F. a 1/6-hp fan maintains balanced room temperature for stored honey combs. Combs are uncapped with an electrically heated uncapping plane, rated 200 w. Then honey is removed.

The extractor, powered by a ⅓-hp motor, throws honey from the uncapped comb by a whirling motion into a 1,200-lb storage tank. In cold weather a 250-w heat lamp over the extractor keeps the honey fluid.

Inside the tank is 400 w of hot-bed wire that warms honey to 125-130 F. Heated honey readily flows through a 100-mesh cloth which removes foreign particles. Electric hot-bed cable, used because of its gradual build-up of heat, prevents the honey from carmelizing which impairs flavor and color.

Form Cold Cathode Group

Cold Cathode Association, Inc., New York, has been formed to promote technological advances and program certification of cold cathode lighting.

(*S & S Shorts on page* 207)

Westinghouse equipment that helps balance cost of voltage regulation with quality of service

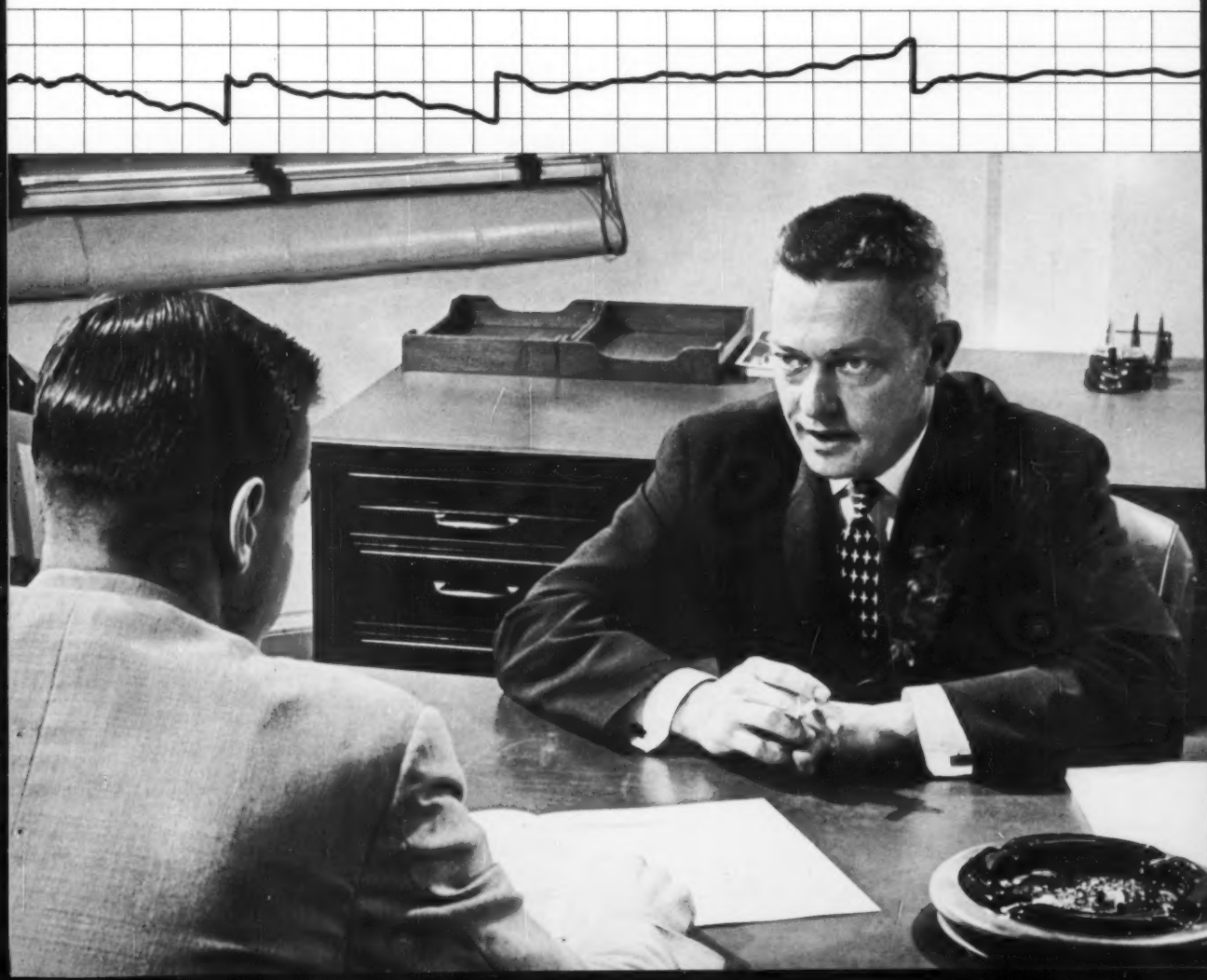
Mr. J. K. Dillard, Manager, Electric Utility Engineering, discusses System Voltage Control:

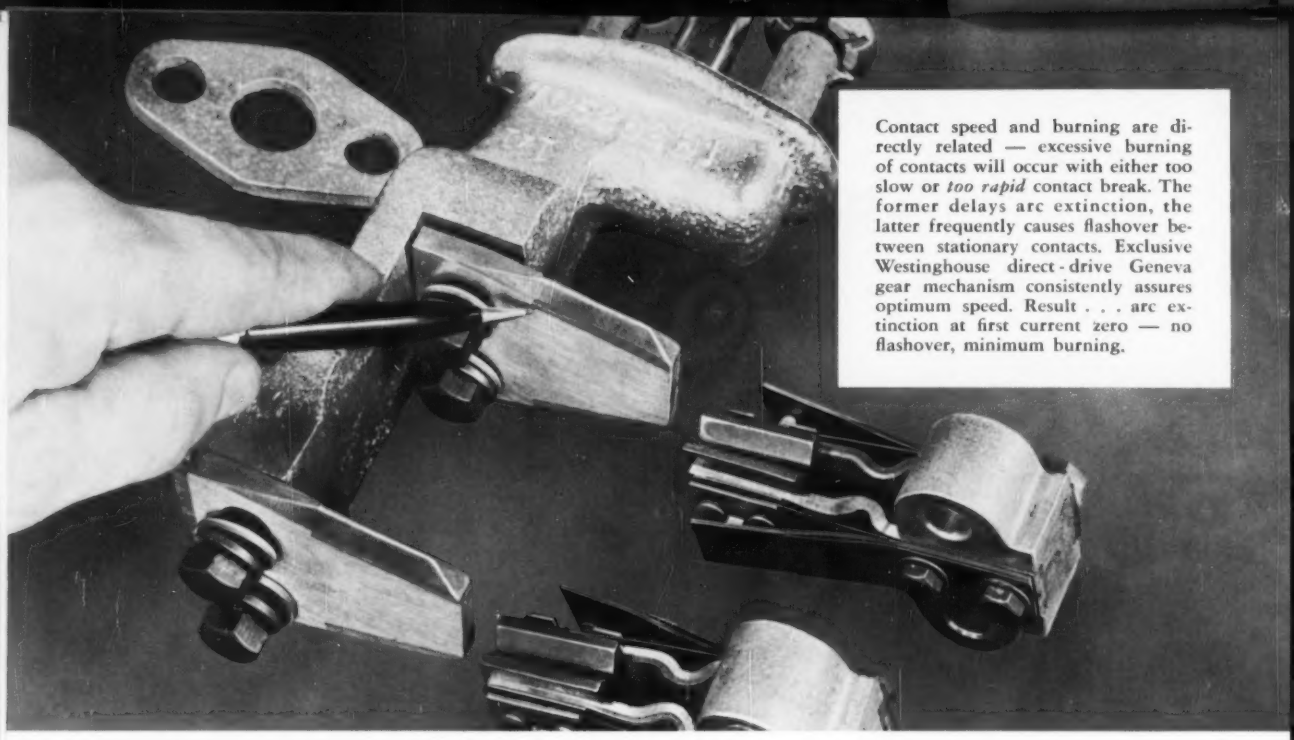
"The Utility Power System is cost sensitive to voltage regulation, a vital factor in quality of service. Westinghouse engineers are continually at work on new ideas and equipment to help solve your voltage regulation problems.

"The following pages show the broad selection of Westinghouse products that make it possible for you to achieve new degrees of voltage control."

WATCH WESTINGHOUSE!

*WHERE **BIG** THINGS ARE HAPPENING FOR **YOU**!*





Contact speed and burning are directly related — excessive burning of contacts will occur with either too slow or *too rapid* contact break. The former delays arc extinction, the latter frequently causes flashover between stationary contacts. Exclusive Westinghouse direct-drive Geneva gear mechanism consistently assures optimum speed. Result . . . arc extinction at first current zero — no flashover, minimum burning.

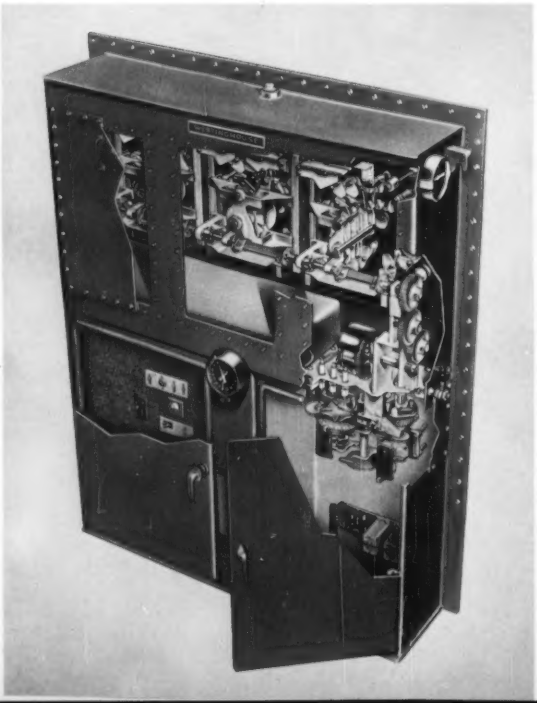
Westinghouse announces 20-year contact life warranty

For URS tap-changing mechanism . . . regardless of number of operations

Field inspections of scores of URS tap-changing mechanisms, in service 8 years or more, show negligible contact wear and burning. Based on this proved performance, Westinghouse now offers a 20-year prorated warranty on contact life — *regardless of number of operations!*

Load tap changers are direct drive; Geneva gear action assures optimum speed of moving contacts to prevent burning. This consistently controlled action is not possible with other types of drives. Geneva gear operation further provides shockless acceleration and deceleration . . . tested to 8 million operations with no appreciable wear.

Result . . . highly accurate regulation, a minimum of operating headaches.



Cutaway of URS operating mechanism reveals industry's only direct-drive load tap changing — positive, consistent, reliable action — backbone of new 20-year prorated life warranty.

New concept in precise voltage regulation

MAGAMP CONTROL

for URS and URT step regulators

Remarkable new MAGAMP* (magnetic amplifier) now standard for URS and URT load tap-changing equipment for both station step regulators and power transformers. MAGAMP sets a new mark in economy of operation. A static, completely sealed sensing device in the Type MS voltage-regulating control, MAGAMP has no moving parts, no need for mechanical adjustments, no maintenance. All settings — band width, balance voltage, line-drop compensation — are made electrically.

The principle of MAGAMP also serves the T.M. time-delay control. One setting integrates time delay for both "raise" and "lower", adjustable in a 5 to 90-second range. Resetting is automatic. In this completely static timing circuit, there is nothing to maintain, nothing to wear out. Relays actuated by this time-delay control have a proved life of more than 25 million operations.

Maintenance-free MAGAMP and unmatched *Geneva gear tap changing* — two of the soundest reasons there are for making this outstanding equipment your next investment in voltage regulation.

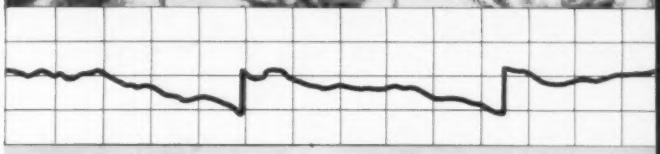
*Trade-Mark

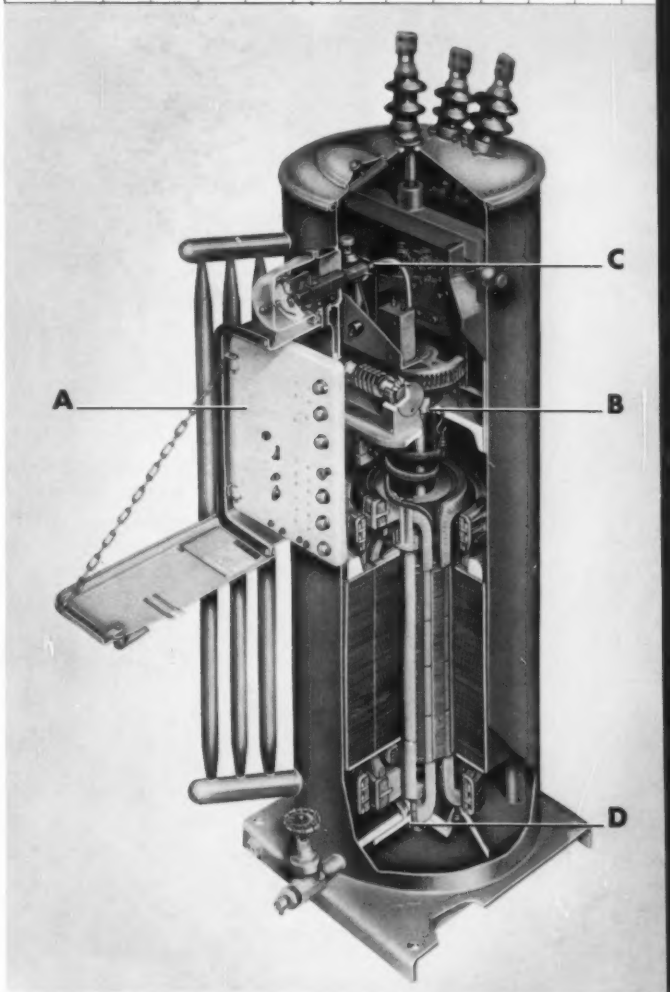
SU INDUCTION REGULATOR

with new 100% compounding MAGAMP gives you *set-it-forget-it* regulation

Two new and exclusive features make the Westinghouse SU regulator a more-than-ever reliable, precise, yet economical voltage control. First, MAGAMP for voltage sensing and motor operation delivers instant pinpoint accuracy. Completely sealed and static, MAGAMP has no moving parts to wear, foul or, consequently, to maintain.

Second, the SU with new 100% compounding returns voltage exactly to set balance level on each correction, thus achieves the narrowest band width — plus and minus a half volt — of any regulator available. The pay-off for you: More revenue dollars through higher effective voltage level.

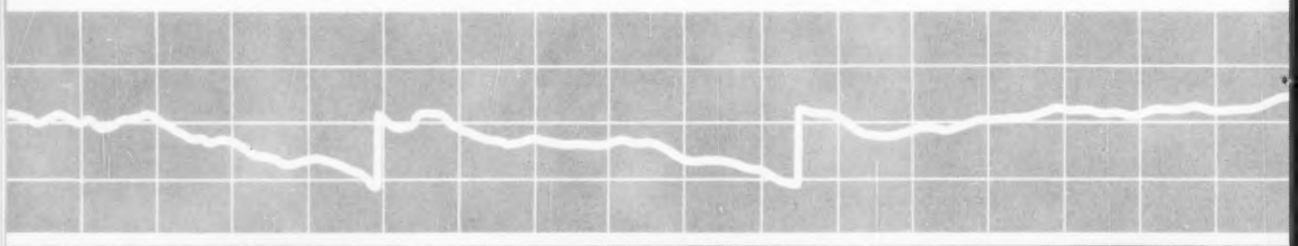


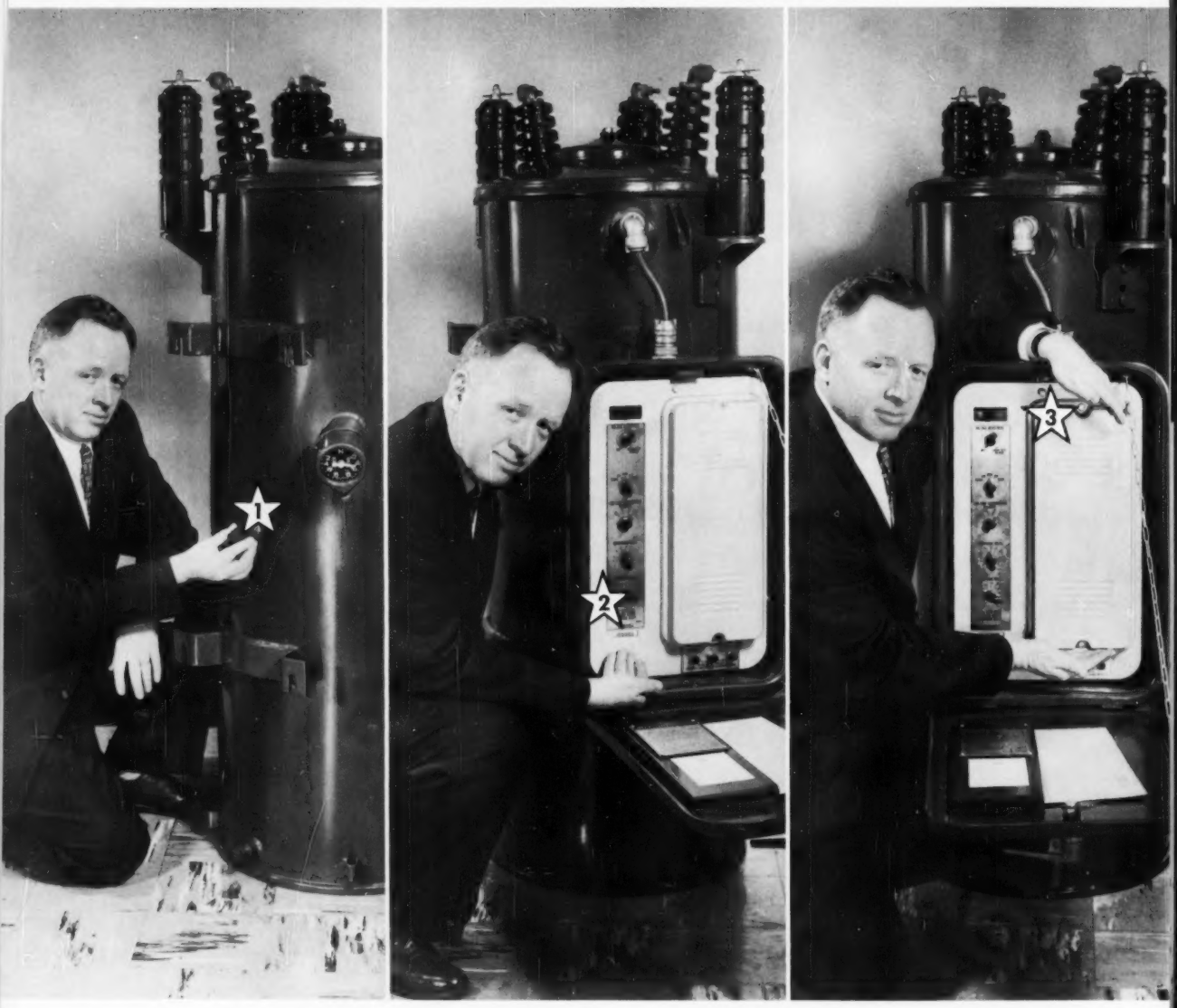


A. Maintenance-free MAGAMP control eliminates all contacts and moving parts. B. Upper bracket and worm gear housing integral castings of nodular iron assure high strength and permanent alignment. C. Swaged adapter assures permanent connection of position indicator drive. D. Permanently preloaded bearings.

WATCH WESTINGHOUSE *WHERE* ***BIG*** *THINGS ARE HAPPENING FOR* ***YOU!***

To improve quality of service with the new Westinghouse URL-16 step regulator . . .





Speed and versatility of the new CVR Westinghouse relay will give you the best obtainable regulation. While pickup or drop of heavy loads can be compensated for quickly — as much as 10 volts in 4 seconds — the relay can be adjusted easily to longer time delays for full range in a 10 to 90-second period for more gradual changes. Above, the URL-16 — (1) exclusive tap-changer compartment drain; (2) simplified control panel with operation counter which aids in keeping accurate operating records; (3) new CVR relay mounts quickly and easily for interchangeability with all previous URL-16 relays.

Unique CVR relay continuously monitors voltage fluctuations, corrects faster

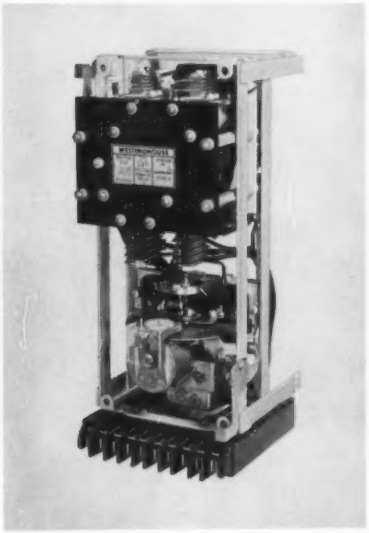
Key to the new performance standards of the URL-16 is the exclusive induction disc CVR relay which actually evaluates the need for speed of voltage correction. The CVR integrates two quantities — voltage and time. (1) It detects rate of voltage change, and (2) it responds with a speed proportional to the rate of change. Sudden or severe line drop — rapid response; slow change — slow response. The greater the need for voltage correction, the faster the relay acts to correct. This double action, combined with a new, faster tap-changer response (full buck to full boost in 13 seconds) gives you precision correction you cannot buy in any other regulator.

Another feature of Westinghouse regulators is the location of tap changer in a separate compartment. This eliminates contamination of transformer oil, fouling of core and coils, and possible flashover faults or overheating. Tap-changer oil is drained separately.

The concept of 1¼% step regulation now takes on new significance as a revenue builder. You can hold to preselected band widths faster, more closely, and more effectively improve voltage level. You get better regulation with less field servicing in the new Westinghouse URL-16.

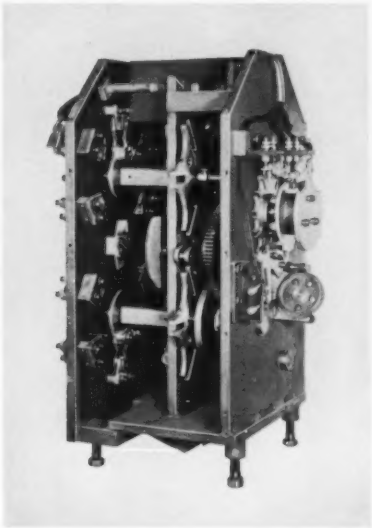
WATCH WESTINGHOUSE!

*WHERE **BIG** THINGS ARE HAPPENING FOR **YOU**!*

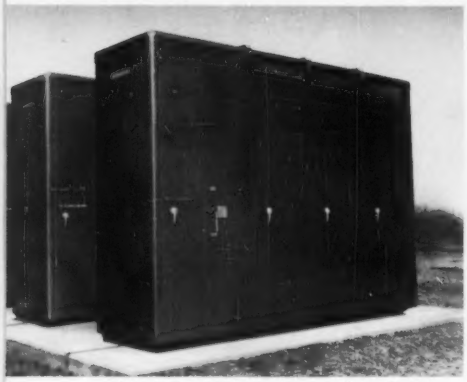


The only settings to be made on the CVR relay are the band width and time delay desired. Full interchangeability with all previous relays used in the URL-16 simplifies field service.

Unit assembly of tap changer and core-coil for greater strength and rigidity. Note separate compartment for tap changer — prevents carbon deposits from entering core and coils.

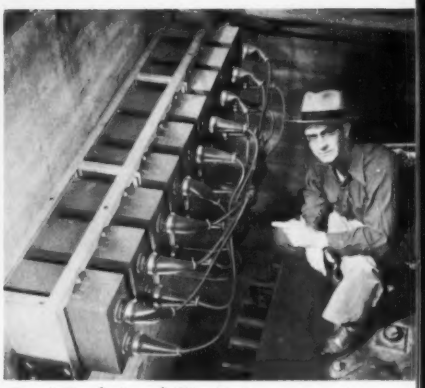


Exclusive Westinghouse direct-drive Geneva gear has no fixed time delay — operates instantly on signal from CVR relay . . . regulator can traverse full buck to full boost in 13 seconds.



Metal-enclosed equipments for substation application assure protection of apparatus and safety of personnel in congested areas.

Westinghouse Autotrol* automatically switched capacitors are factory assembled and connected, ready to install on the pole.



Specially designed Westinghouse capacitors provide quick, economical solutions to the headaches of overloaded networks.

KILOVARS . . .

You'll need one for every two kw added

Westinghouse capacitors are your most effective, low-cost source

A survey of several major power systems, made just a few months ago, estimates that one kilovar of capacitors should be added for every two additional kw of load . . . yet, already, problem areas on many systems are proving these estimates conservative. The wide range of Westinghouse capacitor designs and the broad experience of Westinghouse engineers can help you add kilovars where they will be the most effective, at lowest per-kvar cost.

Westinghouse capacitors offer real economy . . .

. . . because the basic unit in all Westinghouse capacitor equipments is not affected by climate or temperature extremes.

. . . because Westinghouse equipment is available in laborsaving, factory-assembled units for any type of installation — indoor, outdoor, pole-mounted, underground, in stacks, switched or fixed — for all applications from individual motor to large substation banks.

. . . because standardized racks and enclosures simplify installation.

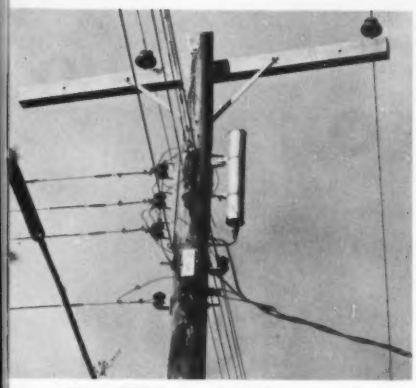
. . . and because continuous improvement in design and manufacturing techniques through a 36-year service record have kept Westinghouse ahead in capacitor development.

The exceptional breadth of experience by Westinghouse engineers in all phases of power factor correction and voltage control is the final and unequaled asset . . . always available to work with you and your consultants.

*Trade-Mark

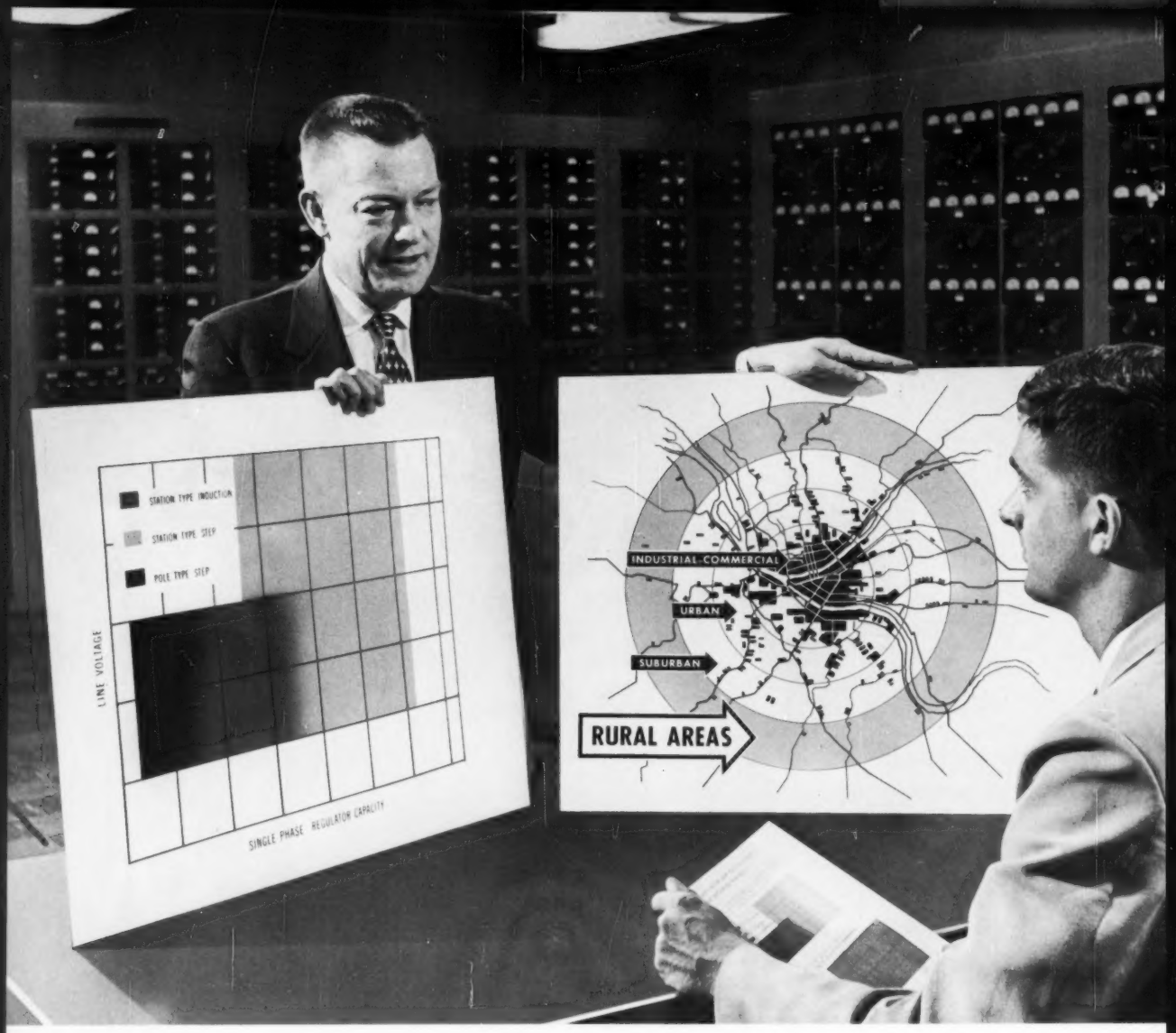
WATCH WESTINGHOUSE!

*WHERE **BIG** THINGS ARE HAPPENING FOR **YOU!***



Type FPS 3, 5 and 7½-kvar distribution capacitors meet the growing needs for supplying kilovars to residential feeders.

A stack-type capacitor installation, like this, consisting of 1005 units supplies 25,125 kvar to offset exceptional I^2X losses on long, peak-load, high-voltage circuits.



More effective voltage regulation per dollar starts with

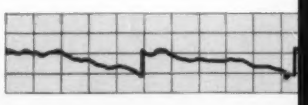
Westinghouse System Analysis and Application Engineering

The trend of modern power systems is well defined. In all directions the signs read "MORE LOAD."

Problems of maintaining proper voltage for both new and established areas are never further away than the following second . . . or the next inch on the system. The answers to proper voltage control depend upon the type of load served, its density, the location of bulk power supplies . . . in short, characteristics of your own particular power system.

In cooperation with your engineers and consultants, Westinghouse can assist with a complete or partial system analysis — the basis for sound equipment recommendations. It's just the kind of assistance that can help you achieve an economical, balanced equipment program, and consistently optimum revenue.

Call your Westinghouse sales engineer for assistance from Westinghouse electric utility engineers, the most experienced in the industry today.



WATCH WESTINGHOUSE *WHERE* ***BIG*** *THINGS ARE HAPPENING FOR* ***YOU!***

CP-1037

THIEL
TRANSFORMER HANGERS
MODEL
TRANSFORMER WEIGHT
C1 75,100 KVA SINGLE PHASE 40 LBS.
C3 75,112½ KVA THREE PHASE 100 LBS.
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THIEL HANGERS are made according to NEMA Specifications—HEAVY STEEL construction, HOT-DIP galvanized for dependable service and long life. Two styles complete with galvanized bolts and nuts.
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FASTENERS
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T-TYPE HANGERS
Easy-Drive STAPLES
NEW "GRIP TYPE" SNAPS ON Easy-on STRAPS
ANOTHER FIRST FOR THIEL
NEW HUMP THIEL PAT. PENDING WILL NOT BREAK OR PULL OUT
Easy-Drive NAIL-IT STRAPS
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• Greatest Improvement in 30 Years
SOLD ONLY THRU LEADING ELECTRICAL WHOLESALERS
THIEL TOOL & ENGINEERING CO., INC.
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S&S SHORTS

Improvement Loans for Built-Ins

The federal government may guarantee some loans for built-in appliances, such as refrigerators, air conditioning units and wall ovens, if they are purchased as part of a home improvement project. Norman Mason, Federal Housing Administrator, says that the agency is studying inclusion of built-in appliances in what are known as Title I home improvement loans. Decision is yet to come.

Dawn of 'Golden Dryer Era'

Between now and 1960, 10.3-million automatic electric and gas clothes dryers will be sold, bringing saturation mark to 29.2. More than 2¼-million units will be sold in next 12 months as the appliance reaches a "golden era." These are forecasts of Harold Bull, director of distribution, Norge Division Borg-Warner Corp. He said the era is that time when saturation is between 9 and 30%. Dryers, now in 10% of homes, are on the threshold.

Customizes Plastic Refrigerators

Vertical or wall-mounted horizontal refrigerators by Westinghouse Electric Corp are expected to speed obsolescence. Materials can be cut to any size or shape permitting a custom-built refrigerator almost as easily as making a pair of special shoes. Cost will probably be comparable to present models. A one-piece, laminated three-layer "sandwich" of plastic or metal is the principal material.

Appliance Service Experiment

Factory servicing of major appliances and TV sets will be tried in three cities—Columbus and Toledo, Ohio and Fort Wayne, Ind.—by General Electric Co. Organizations of servicemen reporting directly to the GE appliance and TV receiver division will be established in the three areas. Company pointed out it is only experiment and doesn't mean factory service will be made nationwide.

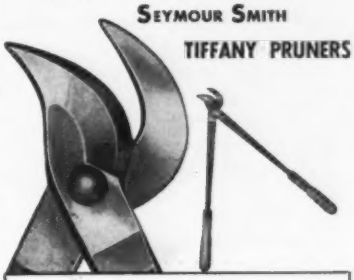
Competitor's Corner

First-half gas water heater shipments totaled 1,461,500 units as of June, up 4.1% over same period in 1955. Shipments for June were 8.9% over a year ago, Gas Age reports.

Illustrated above is No. 11 Tree Pruner with center cut action by tempered steel blade that easily handles 1" branches. Head is reinforced malleable iron. Spruce poles with telescoping aluminum joints. For heavier work No. 12-18, capacity 1½". Also Pole Saws.

for clearing brush...

SEYMOUR SMITH
TIFFANY PRUNERS



Hand forged throughout. Fast and easy double cut action with thin blades shaped to "draw in." Improved bolt and nut joint, through handle and riveted grip fastening.

FAST-CUTTING SAWS

Blades of Swedish charcoal steel. Large, deep teeth with heavy set to prevent binding. Hand and Pole models for all work up to chain sawing.

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SEYMOUR SMITH
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Seymour Smith & Son, Inc.
2410 Main St.,
Oakville, Conn.

NEW EQUIPMENT

Mobility . . .

and a New Rectifier Tube are . . .

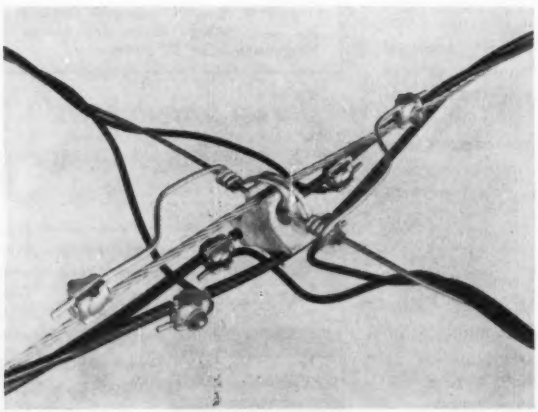
Features of 250-kv DC Cable Tester

A mobile dc cable tester, designated Model 2121, is reported to be capable of delivering from 0 to 250,000 volts at 20 ma, or up to 100,000 volts at 100 ma, using Machlett Type ML 5575/100 rectifier tubes. It is installed in a 7-ton van body.

The unit, which is designed to locate faults in underground transmission cables, is said to be representative of a trend toward non-destructive cable testing by an increasing number of utilities.

The mobile, non-destructive design is said to obviate the need for permanent installation of large ac transformers in generating stations or distribution sub-stations to reach the test voltages of 100 kv or higher. It also does away with the necessity of taking an entire line out of service to locate and "burn" the fault. The tester can be sent to the section under test, reportedly reducing downtime and permitting the use of lines not affected by the fault.

Beta Electric Division, Sorenson & Co, Inc.
333 East 103 Street, New York 29, N. Y.



Triplex Cable Separator

A triplex cable separator, said to facilitate mid span service taps, has been developed. The new insulator is made of Pinco high tension wet plastic process porcelain, which reportedly gives full dielectric protection. It is glazed on all surfaces contacting the conductor and will accommodate up to 2/0 triplex cable.

It is designed for use with either solid or stranded cable.

Samples and complete data concerning the separator, designated L-2181, are available upon written request.

Porcelain Insulator Corp, Lima, N. Y.

(*More New Equipment on page* 212)

Saw Mill Parkway in Westchester County, New York, was the hardest hit of all thoroughfares. HAPCO Aluminum Poles were swamped with flood waters from the overflowing Saw Mill River, yet remained in service without special maintenance. Note luminaires are still in service.

HAPCO Aluminum Poles Stand Firm in Heavy Flood

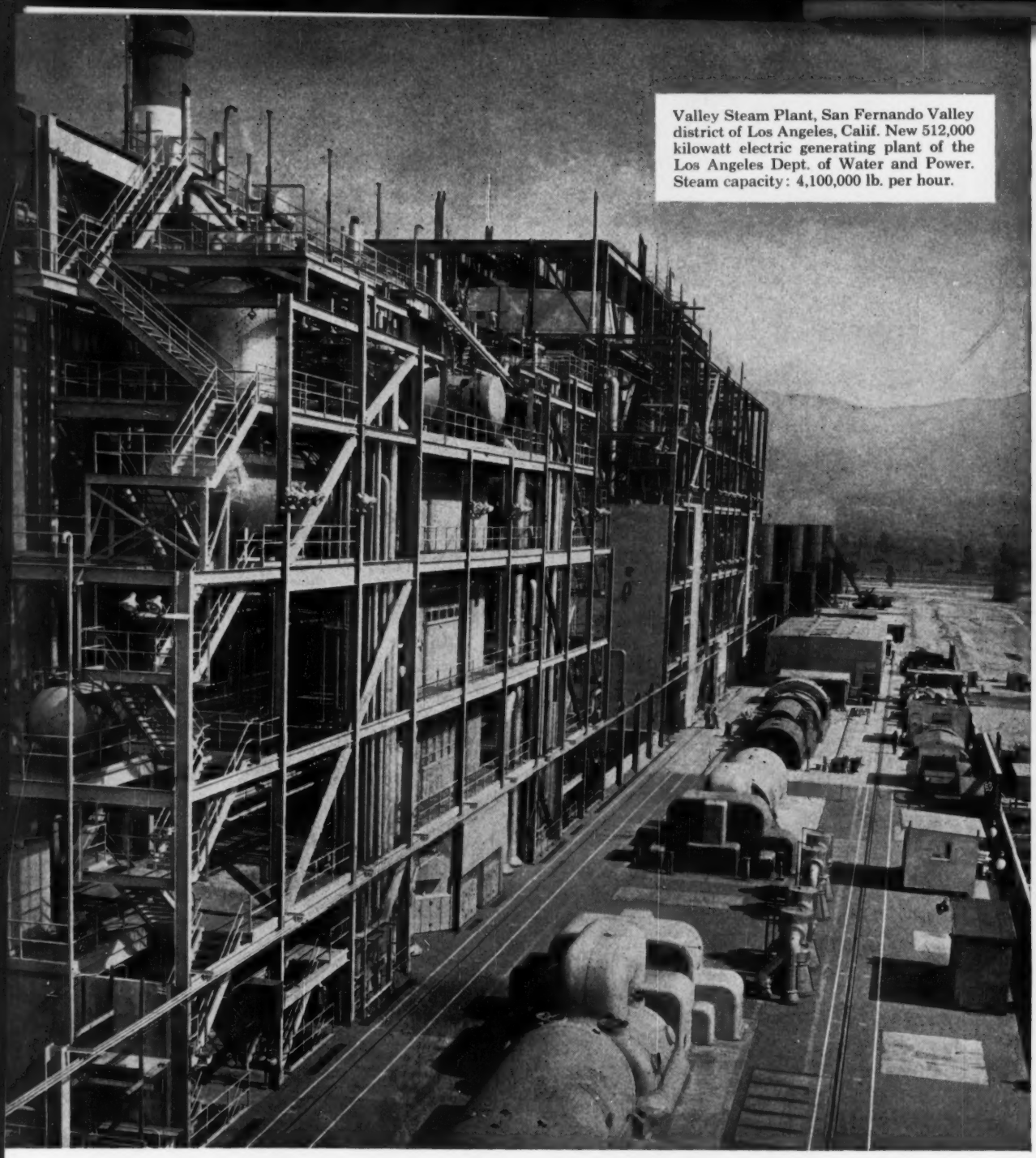
When the year's worst storm hit, dashing seven inches of rain in a three day period on the Yonkers, New York area, parkways were swamped, roadbeds demolished, bridges washed out.

Lighting losses were kept to a minimum because highway planners specified HAPCO Aluminum standards and brackets. HAPCO Aluminum lighting equipment retains its original strength and beauty under the most adverse weather and atmospheric conditions. It requires no initial or maintenance painting, offers the highest resistance to rust and corrosion.

Since HAPCO poles are lightweight, they install faster, easier, you begin saving money as soon as you buy. There is a HAPCO pole designed for every outdoor lighting application. Complete information is presented in Catalog HAL-754. Write for your copy today.

HUBBARD

ALUMINUM PRODUCTS COMPANY
Division of Hubbard and Company
Pittsburgh 1, Pa.



Valley Steam Plant, San Fernando Valley district of Los Angeles, Calif. New 512,000 kilowatt electric generating plant of the Los Angeles Dept. of Water and Power. Steam capacity: 4,100,000 lb. per hour.

How big Valley Steam Plant demineralizes

• Valley Steam's feedwater requirements are typical for today's modern, high-capacity stations. Its raw water supply, delivered from the Los Angeles Owens River Aqueduct, contains 132 ppm total solids but is high in dissolved silica (18 ppm). The 1500 psig and 1850 psig boilers require a large amount of high quality feedwater.

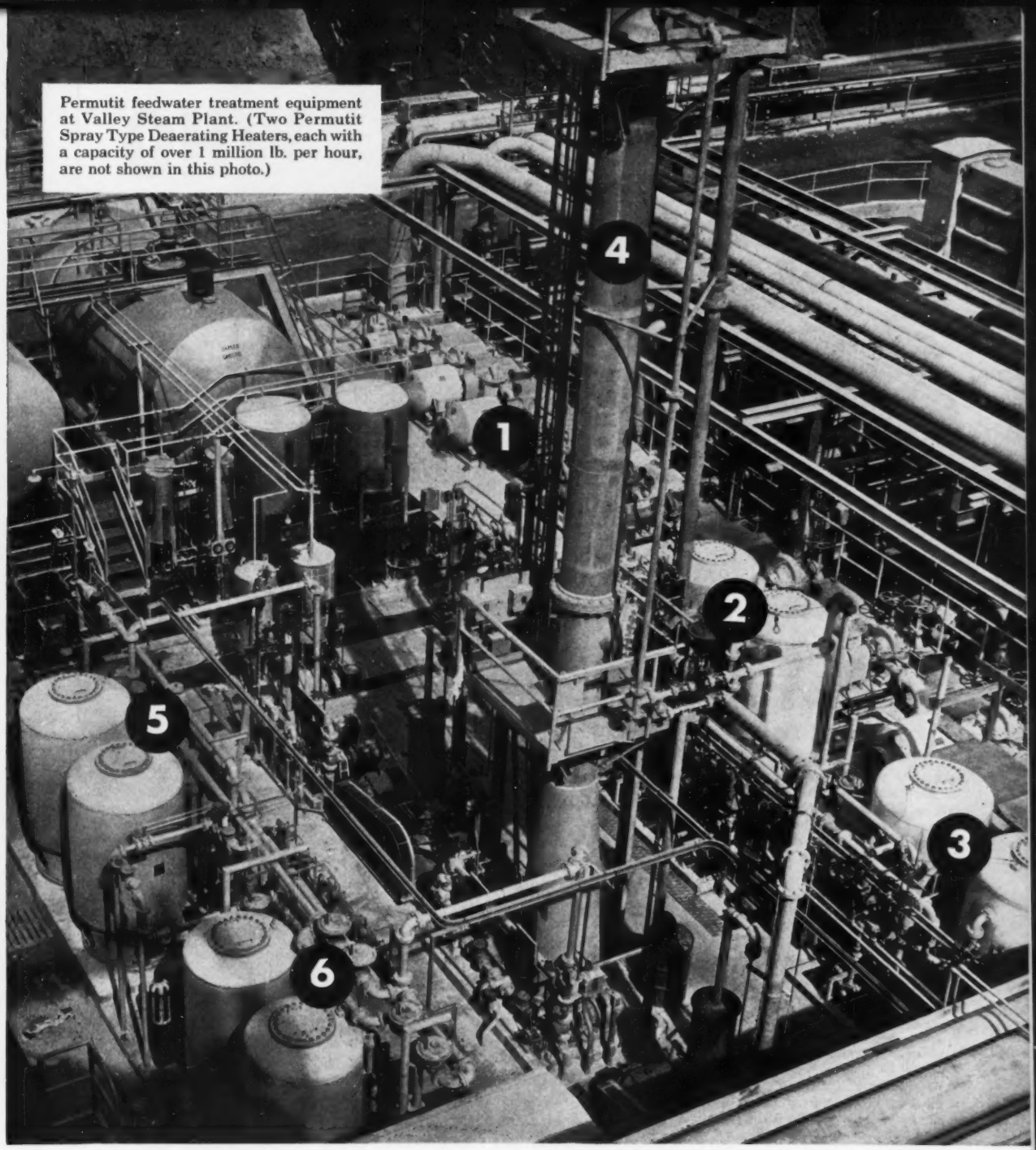
The 4-step PERMUTIT Demineralizer was custom-designed for this problem . . . not only in size, arrangement and number of ion exchange units, but also in the selection of the ion exchange resins.

That's why Permutit's broad experience with many different demineralizing systems and its manufacture of ion exchange resins as well as equipment are of particular value in solving large-plant water problems.

The Permutit Company, Dept. EW-10, 330 West 42nd St., New York 36, N. Y. Permutit Company of Canada, Ltd., 207 Queens Quay, Toronto 1, Ontario.

PERMUTIT EQUIPMENT FOR POWER PLANTS:

Demineralizers • Zeolite and Hot-Process Softeners • Dealkalizers • Deaerating Heaters • Pressure and Gravity Filters • Chemical Feeders • Aerators • Blowoff equipment • CO_2 Indicating Recorders • Zeolites and Resins • Instrument Panels • Control Cubicles



Permutit feedwater treatment equipment at Valley Steam Plant. (Two Permutit Spray Type Deaerating Heaters, each with a capacity of over 1 million lb. per hour, are not shown in this photo.)

its feedwater with PERMUTIT® equipment

1 Diatomite filters (behind column) remove dirt and other suspended matter . . . keep ion-exchanger beds clean for top efficiency.

2 Primary hydrogen cation units contain Permutit Zeo-Karb® . . . remove metallic cations such as calcium, magnesium, sodium.

3 Weakly basic anion units contain Permutit A exchange resin . . . remove chlorides, sulfates, nitrates.

4 Vacuum deaerator removes CO_2 at low cost. Reduces the load on the second stage anion exchangers.

5 Secondary hydrogen cation units (Zeo-Karb) "polish" water by removing "slippage" from first cation units.

6 Strongly basic anion units contain Permutit S-2 resin . . . remove dissolved silica . . . also catch "slippage" from first anion units.

Quality of effluent: Zero free CO_2, under 1 ppm total solids, under 0.2 ppm silica.

For highest efficiency and lowest operating cost, the regeneration of the demineralizing equipment is completely automatic and operated by Permutit instrument panels and control cubicles.

For "small-job sealing"...

Johns-Manville

Duxseal

in the new handy pocket roll

THE NEW HANDY pocket roll makes Duxseal® ideal for small sealing jobs in both installation and maintenance work. It thereby increases the usefulness of your favorite all-purpose sealing and caulking compound.

The NEW pocket roll container allows quick removal and replacement of the compound. Its ribbon form makes Duxseal easy to apply in any amount, large or small.

3 types of Duxseal are now available in pocket rolls:

- **STANDARD DUXSEAL** is a permanently plastic gray-green compound utilizing a non-drying, vegetable-oil vehicle. It will not corrode metals, plastics, wood, rubber, or painted surfaces. It adheres well to all common materials. It is non-staining.
- **TYPE N DUXSEAL** has the same properties plus higher resistance to bleeding or dripping at high temperatures.
- **R-100 DUXSEAL** employs a resinous material as its vehicle and has the same properties. It skins fast to provide an excellent paint surface.

A wide range of other J-M Sealing Compounds is also available in pocket rolls. These are described in sheet EL-85A. Duxseal is covered in sheet EL-68A. Write Johns-Manville, Box 60, New York 16, N. Y.

Johns-Manville

DUXSEAL

Breakers and Enclosures

A new concept in panelboard design for industrial and commercial electrical distribution is reportedly the result of new molded "stab-type" case circuit breakers and enclosures.

Using these breakers and enclosures enables the electrical contractor to assemble distribution panels on the job, which is said to save time, material and money. Interchangeability, simplification of panelboard design and reliability of stab connections to the bus are among the claimed advantages. Various lines of breakers provide plug-in ratings from 12 to 600 v dc and from 15 to 225 amp. Other advantages of some breakers in the line are said to include visible disconnect, safety, ability to carry "temporary light overload," long life due to quick-break mechanism with deionization type arc quenching, tamperproof calibration, interlocking cover-mechanism and groundable neutral.

Panel units can be obtained in four sizes ranging from 16 to 28¾ in. wide and from 48 to 60 in. high.
Federal Pacific Electric Co
Newark, N. J.

Pressure Relief Device

A recently developed mechanical pressure relief device is being supplied all the manufacturer's large power transformers that use an automatic gas-seal, gas-oil-seal, or sealed type bank of oil preservation system. The device is said to limit excessive internal pressure resulting from any abnormal condition.

Mounted on top of the transformer, the device is ruggedly constructed and protected by a steel cover. Under normal conditions, a toggle mechanism holds the gasketed cover securely in

(*Continued on page* 216)

WHO

LEADS THE LEAGUE IN COVERED CONDUCTOR?

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BY THE MEN WHO INSTALL THEM

...because they've got MORE ROOM to work in, get the job done easier—faster—safer.

There's MORE WORKING SPACE between the skirt of the insulator and the clevis pin—plus—an EXTRA LONG CLEVIS PIN for ease of handling during routine construction—a must for Hot Line applications.

Minimize YOUR interruptions of service the PREFERRED way — Specify PORCELAIN PRODUCTS, INC. #66200.

PP INC.

Porcelain Products, Inc.
High Voltage Division **Parkersburg, W. Va.**

New plant uses for station

Southern California Edison Co. Saves Building Costs at New Redondo Station

Cut costs . . . maintain power continuity! These were the big considerations at Southern California Edison Company. The use of outdoor station auxiliary switchgear helped in cutting overall costs. And the carefully planned circuit schemes described here help in maintaining continuity of service for the station auxiliaries.

First step in assuring power continuity was setting up two independent power sources for auxiliaries.

(1) *An auxiliary generator direct-connected to the main generator shaft.* Supplies main auxiliaries during normal operation . . . provides a power source independent of system disturbances.

(2) *A local 69-kv line through a step-down transformer bank.* Provides a reserve and start-up source, and supplies general station requirements such as soot blowers and spare exciter.

The 4160-volt main station service bus is divided into East and West bus connected through a bus section breaker. Each section supplies about half the auxiliary power requirements. If either bus is removed, approximately 65% capacity can be maintained.

The Allis-Chalmers outdoor 4160-volt switchgear is rated at 250,000-kva interrupting capacity and is physically split as indicated by the one-line diagram. Three types of protection are provided: overload, undervoltage and fault.

Motors are tripped off the line and an alarm is sounded if heavy overload occurs. No alarm is given on light overload.

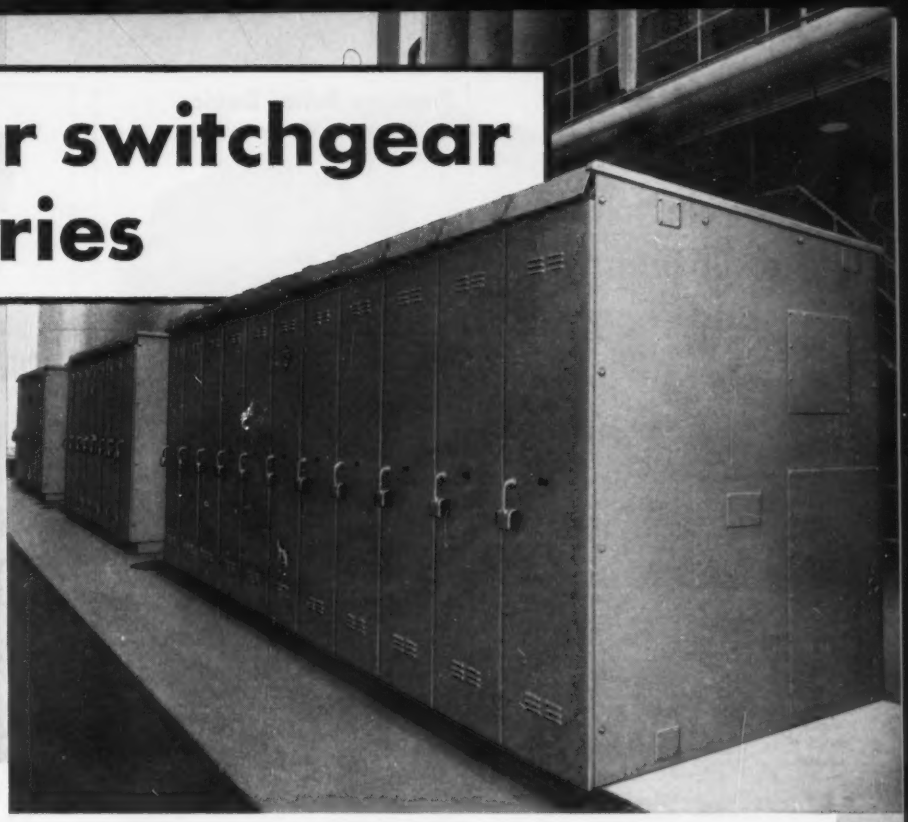
An undervoltage condition on main bus (East and West buses combined) will initiate an automatic throwover from the auxiliary generator to the reserve supply.

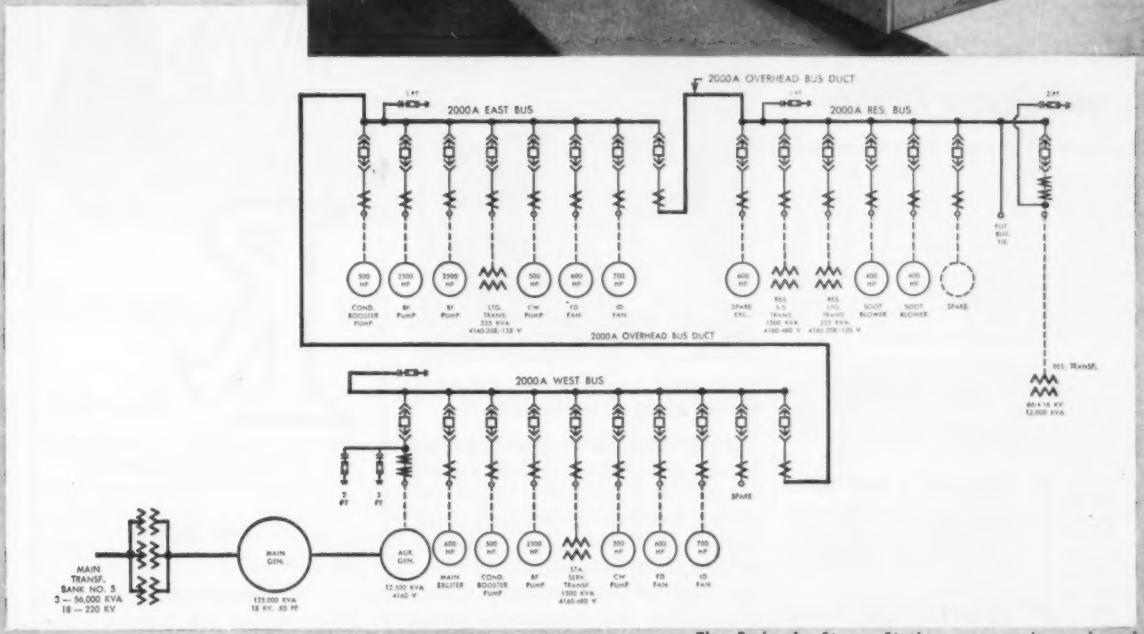
In the event of a fault in the generator circuit or in the generator, provision is made for automatic transfer from auxiliary generator to reserve source.

for Progress in Switchgear **ALLIS-**

outdoor switchgear auxiliaries

Allis-Chalmers engineers worked in close cooperation with Stone & Webster Engineering Corporation and Southern California Edison Company engineers on this project. It is one of many station auxiliary switchgear lineups built by Allis-Chalmers. For an answer to your switchgear problems, call your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.





The Redondo Steam Station was engineered and constructed by Stone & Webster Engineering Corporation.

If there's a fault on either the East or West bus, the section is automatically isolated so disturbances will be kept to a minimum.

During normal operations it is possible to transfer to the reserve supply by first opening the normal supply — then closing the reserve bus tie.

To provide added flexibility there is also provision for make-before-break manual transfer from normal to reserve power supply by closing the reserve bus-tie breaker, after synchronizing the two sources of power, and then opening the normal supply breaker.

CHALMERS

A-C ALLIS-CHALMERS

A-5217

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Electrical Maintenance and Repair Library

5 volumes 2112 pages 1801 illustrations

This Library starts you right at the beginning and takes you, step-by-step, through every phase of connecting, altering, testing, and repairing all types of electrical equipment. It shows you how to install motors and generators, and rewind motors—how to inspect and repair starters—locate trouble—test induction motors—and MUCH MORE! Hundreds of diagrams make everything crystal-clear. Here are the best on-the-job practices of the experts that will help to put you in the big pay class—and rate you as an EXPERT electrical worker!

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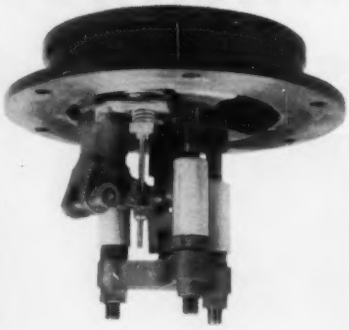
Pressure Relief Device

(*Continued from page* 212)



place. If the internal tank pressure rises above 15 psi, a bellows releases a pivoted latch, allowing the toggle to collapse and the cover to lift, relieving the pressure.

General Electric Co
Schenectady 5, N. Y.

Recording Oscillograph

The "Visicorder", a recording oscillograph that produces readable records instantly, is designed for 115-volt, 60-cycle operation. It has a flat frequency response of 2,000 cps, and is claimed to combine the high-frequency characteristics of photographic oscillographs with the convenience of a writing instrument.

It will accommodate six channels on a 6 in. chart; chart speeds are 0.2, 1.0, 5.0, and 25 in. per second, minute or hour. It holds 100 ft of record and can be loaded in daylight. An indicator shows the amount of unused record.

Weight is about 45 lbs. Size 10 in. high, 14 in. deep, and 10 in. wide.

Heiland Div, Minneapolis-Honeywell Regulator Co, Denver 22, Colo.

(*More New Equipment on page* 220)

WHO CALLS THE PLAY IN COVERED CONDUCTOR?

Remember

. . . in the dynamic electric power industry, only World can do World's* work . . .*

***Electrical World**
that is . . .

Anaconda specifies Enjay Butyl rubber

TO DEFY OZONE IN HIGH-VOLTAGE CABLES...

for more current per circuit... more power per dollar

Anaconda specifies Enjay Butyl insulation for high-voltage cables because this rubber has incredible resistance to ozone. Surpassing the industry's standard three-hour specification test, Enjay Butyl insulation used by Anaconda showed *no injury after 72 hours* of ozone concentration tests—24 times longer than specification requirements. Other rubbers would deteriorate and crack in a fraction of this time.

With the help of Enjay Butyl, millions of feet of Anaconda's cable now in use deliver more current per circuit, more power per dollar.

Perhaps *your* product, too, can be improved with versatile Enjay Butyl. It comes in non-staining grades for white and light-colored parts, offers excellent electrical properties, low price and *immediate availability*. For full information, contact the Enjay Company. Complete laboratory facilities and technical assistance are at your service.

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Enjay Butyl is the super-durable rubber with *outstanding* resistance to aging • abrasion • tear • chipping • cracking • ozone and corona • chemicals • gases • heat • cold • sunlight • moisture.

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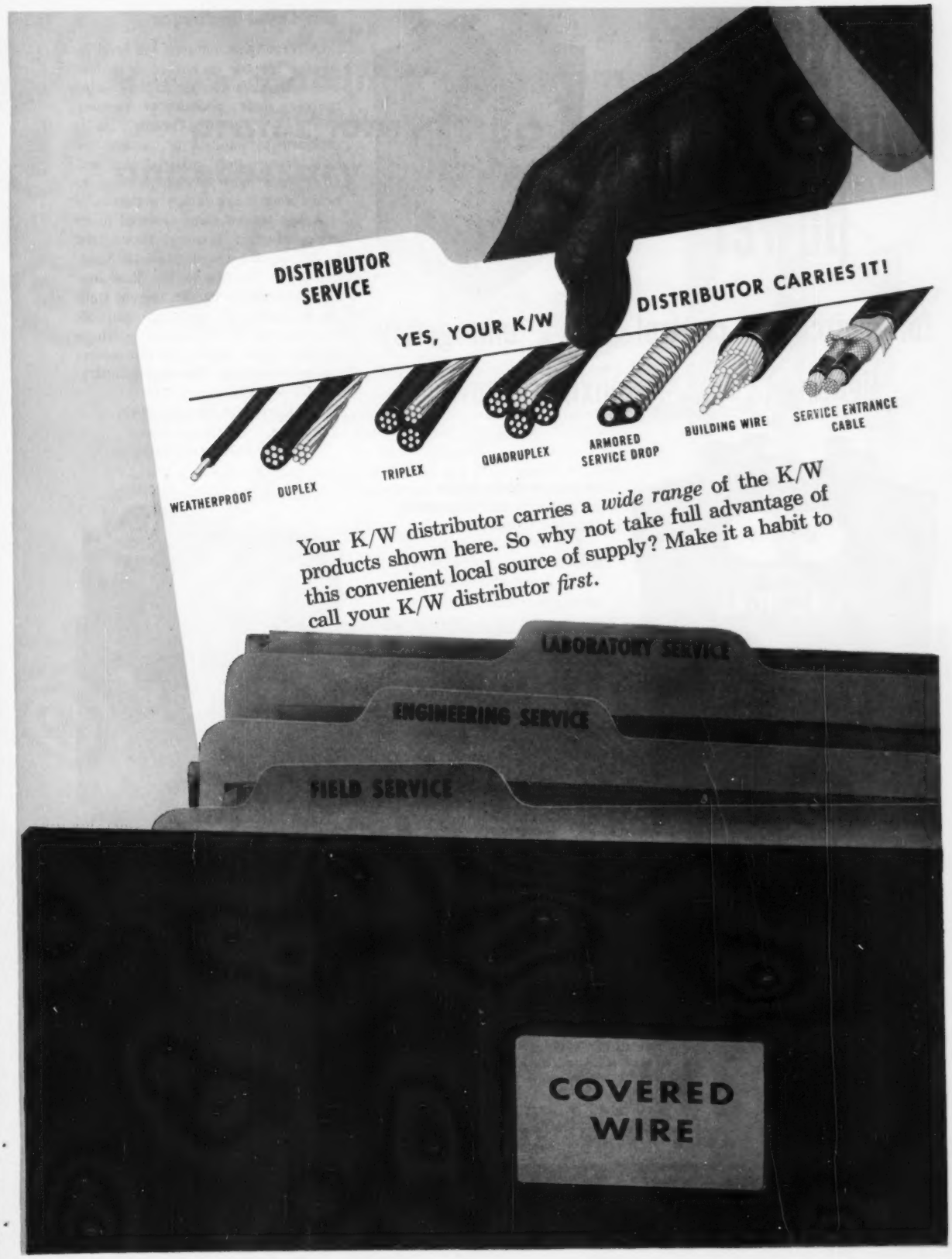
Kaiser Aluminum

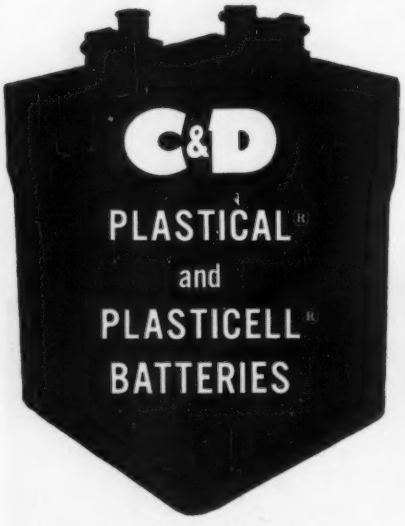
Aluminum is the answer to Adequate Wiring

K W KNOWS THE SCORE


DISTRIBUTOR SERVICE
YES, YOUR K/W DISTRIBUTOR CARRIES IT!
WEATHERPROOF
DUPLEX
TRIPLEX
QUADRUPLEX
ARMORED SERVICE DROP
BUILDING WIRE
SERVICE ENTRANCE CABLE
Your K/W distributor carries a *wide range* of the K/W products shown here. So why not take full advantage of this convenient local source of supply? Make it a habit to call your K/W distributor *first*.
LABORATORY SERVICE
ENGINEERING SERVICE
FIELD SERVICE
COVERED WIRE

Now—"engineered" power

for switchgear-control —emergency lighting —auxiliary power



Compact, modern-design "power plants" engineered for specific applications! C & D PlastiCals and PlastiCells give you completely dependable power—*where power must not fail!*

PlastiCal—with lead-calcium grids for maximum life—is conservatively engineered for at least 25 years in full-float service. PlastiCell—with high-tensile alloy grids—has a projected life of 14 years in float service.

WITH BOTH PLASTICAL AND PLASTICELL YOU GET SUCH ADVANCED C & D DESIGN EXTRAS AS:

1. Extra-long life—exclusive design combines advantages of both suspended and supported plate construction.
2. Triple insulation—thick Fiberglas mat, microporous separators, and perforated Koroseal retainer.
3. Saftec-Vent—outstanding C & D development that prevents accidental battery explosions.
4. Crystal-clear plastic jars—heat-resistant and hermetically sealed.
5. Plastite Post Seals—for easier maintenance, and at the lowest lifetime cost.

Write for C & D Specification Bulletins:
CP-536 Rev. 1 on PlastiCal Batteries
CP-537 Rev. 1 on PlastiCell Batteries

C&D BATTERIES, INC.
of Conshohocken, Pa.
Industrial Batteries since 1906

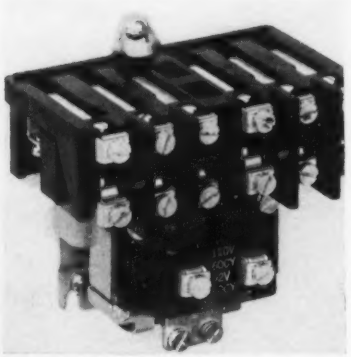
SALES AND SERVICE OFFICES IN PRINCIPAL CITIES FROM COAST TO COAST

Bin Level Indicator

A rotating-paddle-type bin level indicator for use in hazardous atmospheres is said to be particularly suited for bins under pressure or vacuum. Called a "Roto-Bin-Dicator", it is designed to indicate or control the level of any bulk material that will flow, from light aerated powders to heavy abrasive or lumpy materials.

A low torque motor, located in an explosion-proof housing, rotates the paddle at slow speed. Material building up in the bin to the Roto-Bin-Dicator stops the paddle, thereby stalling the motor. As the motor stalls, its torque actuates a precision switch to control signal lights, horns, motors for conveyors or feeding machinery.

Bin-Dicator Co
13946 Kercheval, Detroit, Mich.



Machine Tool Relay

A 6-pole, in-line, 10-amp relay (NEMA Type A1B) designed for applications such as machine tools and control panels is now available. The unit reportedly increases flexibility and conserves panel space by reducing the number of extra relays necessary in automatic control systems. A saddle-type terminal permits wiring from four directions with either plain wire or crimped-on terminal connections.

All terminals of the machine tool relay are accessible from the front of the unit. Other features designed to help cut installation cost are captive clamps and panhead screws.

The relay is available in 2, 3, 4 and 6-pole models and in all voltages and frequencies up to 600 v, 60 cycles.

General Electric Co
Schenectady 5, N. Y.

(*More New Equipment on page* 222)

FAST OR SLOW

...here's coordinated system protection without unnecessary interruption

CHANCE

(FORMERLY MATTHEWS)

K&T Fuse Links

These NEMA Standard fast or slow Fuse Links have the uniform quality vital to proper coordination.

Auxiliary tubes are used on links through 100 amperes for positive circuit interruption of low fault currents. They also protect the fusible element from damage.

Low amperage links (20 amps and below) are fitted with a stainless steel push-out spring for added assurance of low fault current interruption.

Flexible cables are lead-coated for maximum resistance to corrosion.

Easy to use time-current curves are available to help you plan your coordination.

CF55-5

PACKAGED THE WAY YOU ASKED FOR THEM

An overwhelming majority of power companies, in response to a survey, asked for fuse links to be packaged and identified like this! Links rated 100 amperes and below are packaged in sturdy 5-link containers. Links over 100 amperes come in 3-link containers. Each of the joined packages is a container in itself. Perforation permits easy, immediate separation of each unit.

Lineman can easily pull out a link while wearing gloves. For convenience, five 5-unit containers (25 links) are packaged in a carton and three 3-unit containers (9 links) come in a carton. Everything, including the link, is clearly identified. Each link is stamped to show type and rating. Link type and rating is printed in big type on both ends of each single unit container. The large shelf package also clearly shows type, catalog number, rating and time-current characteristic curve numbers.

ABC INDUSTRIES

A·B·CHANCE CO.

General Offices: Centralia, Missouri

(*Continued from page* 220)

Vertical Gearmotors

A line of vertical, shaft-up gearmotors for use in cooling tower fans is available. The Type U gearmotors are designed to replace present systems that use a separate right-angle speed reducer driven by a horizontal motor through a floating, flexibly-coupled shaft.

They are available in ratings from 15 to 75 hp with motor speeds of 1150 and 1750 rpm. Gear efficiencies of 98% are reportedly possible with single-helical gears. Output speeds from 170 to 780 rpm can be obtained. Floating shafts, couplings, and motor mountings bases are said to be eliminated.

Only one supporting structure is necessary, according to the manufacturer. Gears and bearings are held in a one-piece housing equipped with an inspection plate for examination. Squirrel-cage motors can be furnished for all polyphase power supplies.

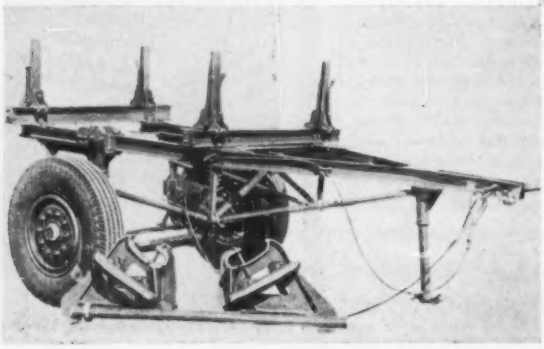
Westinghouse Electric Corp
P.O. Box 2099, Pittsburgh, Pa.

Horizontal Break Switch

A 600-amp horizontal break switch augments this manufacturer's line of outdoor group-operated disconnect switches. The type PH switch, designed for horizontal, vertical, or inverted mounting, is rated from 7.5 through 69 kv. It can be used for sectionalizing, disconnecting and bypassing applications and is said to meet the latest NEMA specifications.

The switch incorporates a swivel type, full-floating contact assembly on the stationary insulator. This reportedly assures low operating effort and positive ice-breaking action.

Line Material Co, Milwaukee 1, Wis.



Reel & Pole Trailer

Utilities may be interested in this combination cable reel and pole trailer. It can be equipped for transporting cable reels using standard reel saddles and guides. For carrying poles or general cargo, interchangeable bolsters are also provided. Conversions from bolsters to reel saddles can be made in the field using standard hand tools.

Adams Engineering Co, Solon, Ohio

(*More New Equipment on page* 227)

this is LOADBUSTER

IT'S PORTABLE

IT GOES ON YOUR TRUCKS

IT BREAKS LOADS ANYWHERE ON YOUR DISTRIBUTION FEEDERS

NOW... LOADBUSTER

Breaks Loads with Open Cutouts

LOADBUSTER is ruggedly built for repetitive service with S&C open cutouts wherever they are applied. There is no broken link to replace after switching. Both the cutout and LOADBUSTER are ready immediately for repeat service. Moreover, the high interrupting capability of LOADBUSTER permits load breaking even when the cutout carries the 200 ampere disconnect blade. Also, it can interrupt any steady overload the cutout may be carrying (as much as 200 amperes with a 100 ampere link).

- **Put LOADBUSTER on each of your line trucks**
- **With it your lineman is ready to break the circuit instantly up and down your distribution system**
- **It just hooks across an S&C disconnect or S&C open-type cutout to provide safe, arc-free interruption**

...A *Portable* LOADBREAK TOOL

With the advent of the revolutionary LOADBUSTER, an entirely new concept in circuit switching is born, one that brings complete, positive, safe switching for distribution systems within the reach of any utility's pocketbook. For LOADBUSTER is a circuit interrupting device which is portable, is repetitive, and is universal.

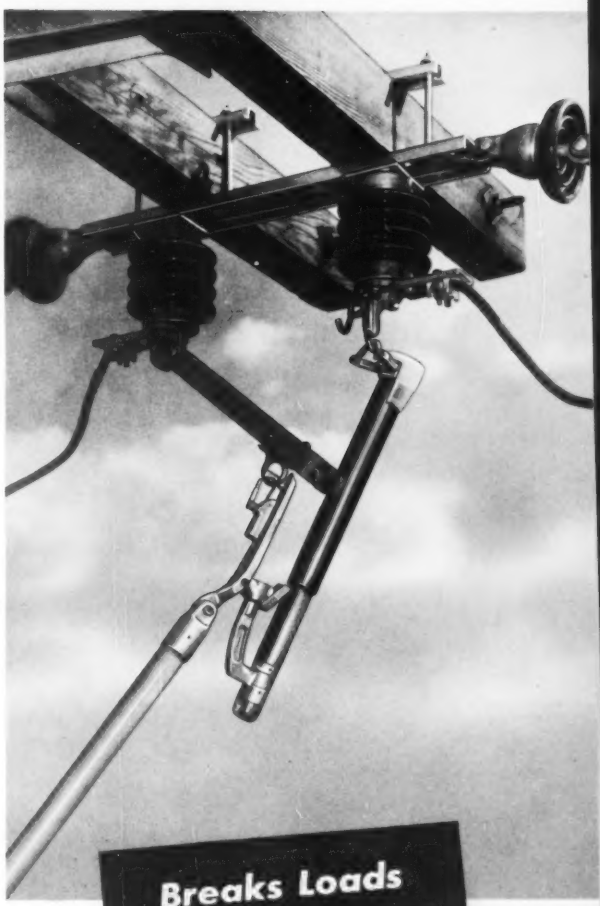
Disconnects and cutouts inherently have no positive switching capability. To get it, some interrupting means must be built into them. For example, a link breaking device must be built into an open cutout; an interrupting unit into a disconnect which then makes it a load interrupter switch. This costs money !!! BUT, bringing the interrupting device to the disconnect or cutout only when needed eliminates this cost . . . that's what LOADBUSTER does . . . it's a loadbreak tool.

With LOADBUSTER you can drop all tedious, uneconomical, and unsafe switching practices. Attached readily to a universal pole, LOADBUSTER is simply hooked across the upper contact of a disconnect or cutout which is then opened in the normal way. It's just that easy! There's no arc, no link breakage, no fuss, no worry, no contact burning, and no danger to the operator. After use, LOADBUSTER is returned to the truck ready for instant use again anywhere.

LOADBUSTER can be used over and over again. It will withstand daily field usage over a long period of time without requiring maintenance. On the other hand, because it's portable, it's available for easy inspection. It's a circuit interrupting device that can always be kept in top-notch condition.

LOADBUSTER is operable at any distribution system voltage through 14,400 volts, and is able to break all load currents through 400 amperes, as well as associated magnetizing and charging currents. It can also switch all pole-top capacitor banks.

Ask for Descriptive Bulletin No. 730.



LOADBUSTER provides arc-free circuit interruption with S&C disconnects rated 400 amperes and 14.4 kv. It also will be usable with an S&C pole-top regulator switch.

Specialists in High-Voltage Circuit Interruption since 1910

S&C ELECTRIC COMPANY

4435 RAVENSWOOD AVENUE • CHICAGO 40, ILLINOIS, U. S. A.

In Canada: S&C Electric Canada, Ltd., 8 Vansco Road, Toronto 14, Ontario

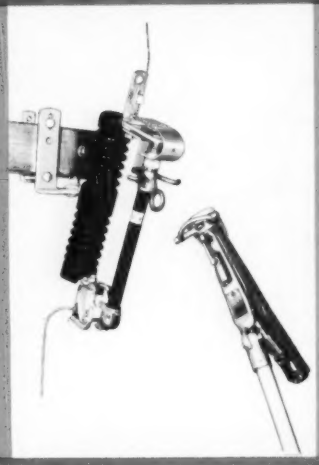
POWER FUSES • CUTOUTS AND FUSE LINKS • LOAD INTERRUPTERS • METALCLAD SWITCHGEAR

HOW TO USE LOADBUSTER

THE LOADBREAK TOOL

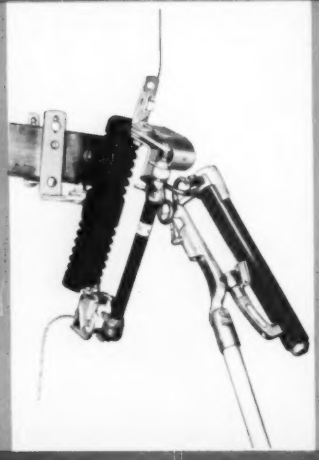
1

Being light in weight and having universal joint action, LOADBUSTER can approach from any angle, any direction, and any distance. LOADBUSTER manipulates freely.



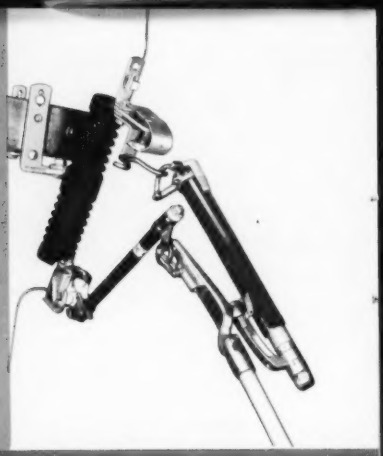
2

LOADBUSTER is now hooked across the upper contact.



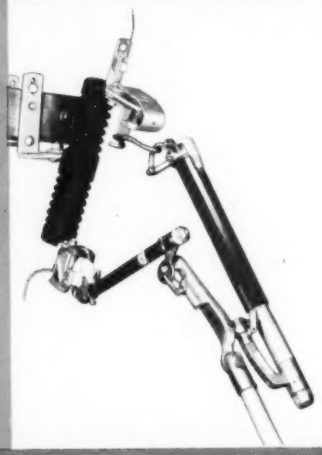
3

Cutout is pulled open in the conventional manner with LOADBUSTER, through which the current is now shunted.



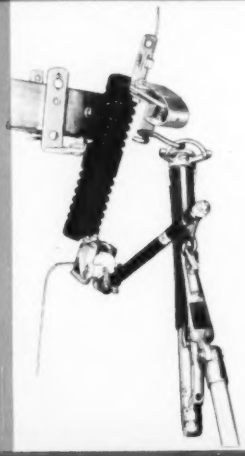
4

As opening motion progresses, LOADBUSTER trips, breaking the circuit positively, without any external arc.



5

With a simple twist of the pole, LOADBUSTER is disengaged for immediate loadbreak services elsewhere.



S&C

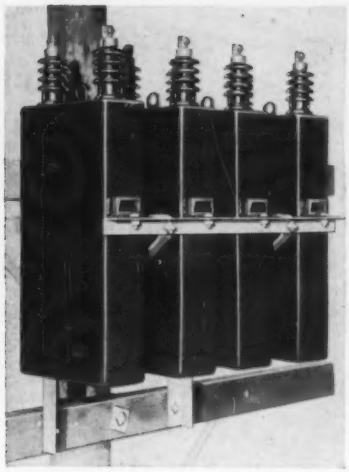
Specialists in High-Voltage Current Interruption Since 1910

S&C ELECTRIC COMPANY

4433 RAVENSWOOD AVENUE • CHICAGO 40, ILLINOIS, U. S. A.

In Canada: S&C Electric Canada, Ltd., 6 Vansco Road, Toronto 14, Ontario

POWER FUSES • CUTOUTS AND FUSE LINKS • LOAD INTERRUPTERS • METALCLAD SWITCHGEAR



Capacitor Hanger

A standard four-unit capacitor hanger, made of hot-dip galvanized steel is said to have the structural strength to meet the demand for sturdier hangers. It will support 50-kvar units, and provides interchangeable mountings for three or four 15, 25, and 50-kvar units. The hanger is said to conform to National Electrical Manufacturers Association specifications.

Line Material Co, 700 W. Michigan Street, Milwaukee 1, Wis.

Radioactivity Monitor

A mobile air monitor with fixed or moving filter automatically measures and records airborne radioactivity, and warns by light or bell when preset limits are exceeded. Known as Model AM-3A Air Monitor, the unit is designed for protection of personnel wherever radioactive materials are handled. It reportedly easily detects the maximum permissible concentration of airborne beta and gamma activity as specified by the National Bureau of Standards.

Airborne particles are collected on a filter which may be operated as a fixed filter to provide an accumulative record, or as a continuous moving filter with several speed choices for showing instantaneous changes.

The unit is said to operate for 7 to 10 days unattended, providing a permanent legal record on a continuous chart of either short term high level or slowly changing low level radioactivity.

Nuclear Measurements Corp, 2460 N. Arlington Ave, Indianapolis 18, Ind.

Fire Extinguisher

A dry automatic chemical fire extinguishing system for flammable liquid, electrical and textile fire hazards is said to be compact and low cost. Intended primarily for protection of moderately- sized hazards, the Ansul PS-30 extinguisher consists of a 30-lb capacity dry chemical unit installed near the hazard and a special CO_2 gas pressure cartridge which furnishes pressure to expel the dry chemical onto the fire through a piping system.

Depending on the requirements of the hazard, the system can be preset to provide total flooding or local application. It may also be operated either manually or automatically. The system reportedly may be charged right at its location and put back into use immediately after a fire.

Ansul Chemical Co, Marinette, Wis.

Transistorized Speaker

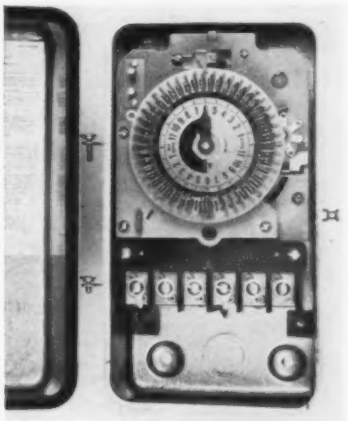
A mobile communications type speaker with a built-in transistor amplifier reportedly provides up to ten times the audio output of standard passive speakers in mobile two-way radio installations. Called the "Power Voice," its amplifier uses two power transistors and has a flat response from 300 to 3000 cps. Input impedance is 3.2 ohms, which is compatible with most communications type receivers. Battery drain on standby is 0.3 amp and 1.0 amp with full voice output. The unit comes in a steel case measuring approximately 5¼ x 5¼ x 3¼ in, weight about 6 lbs.

Motorola Communications & Electronics, Inc, Chicago 51, Ill.

Cathode Ray Oscillograph

A cathode-ray oscillograph is said to combine visual and mechanical efficiency with great reliability. Designated Type 401, the new oscillograph offers calibrated sweeps, both driven and recurrent, division of the front panel into visual and manual areas by use of an offset frame, new lettering styles, and rearranged groupings of control knobs in basic "blocks of function." A read-out system on calibration controls reportedly makes the 401 a digital device for reading amplitude and time. Other features include direct coupled high gain X- and Y-amplifiers, amplitude calibration on both channels, a self-regulating power transformer for better stability, and an electronically regulated B+ and high voltage power supply.

Allen B. DuMont Laboratories, Inc, 760 Bloomfield Ave, Clifton, N. J.



Multi-Tripper Time Switch

A general purpose time switch, designated TSA-555, has a multi-tripper dial for flexibility of time setting. TSA-555 permits use whenever many varied on-off schedules are required during a 24-hour period. Use of an optional feature, a pair of intermittent contacts, is said to make the time switch well suited to oil-well pumping and irrigation control. Other applications reportedly include heating, air conditioning, poultry feeding, refrigeration and operation of automatic machines.

General Electric Co
Schenectady 5, N. Y.

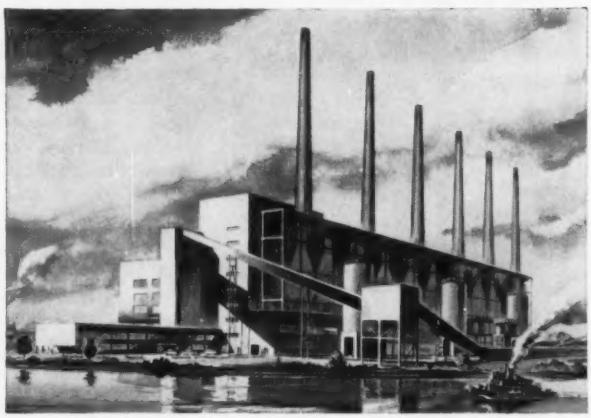
(*More New Equipment on page* 230)

"BUFFALO" FANS SUPPLY INDUCED DRAFT FOR WORLD'S LARGEST GENERATOR UNITS

Shown here is one of four "Buffalo" Double Inlet I. D. Fans serving the boilers for the world's largest turbine units. Rated at 260-Mw each, one of these two turbine-generators is operating at the River Rouge Plant of the Detroit Edison Company.

Frequent selection of "Buffalo" Draft Fans by leaders like Detroit Edison speaks volumes for the dependability and efficiency designed into these fans. We call it the "Q" Factor, the Built-in Quality which provides trouble-free satisfaction and long life.

"Buffalo" Draft Fans are designed for *modern* power plant requirements — in choice of backward curve, airfoil, radial and forward curve types — to provide the best fan for any operating conditions. Write or phone your nearest "Buffalo" Engineering Representative for recommendations on the best fans to meet your operating conditions.



Proposed 6-unit River Rouge Plant of Detroit Edison Company.

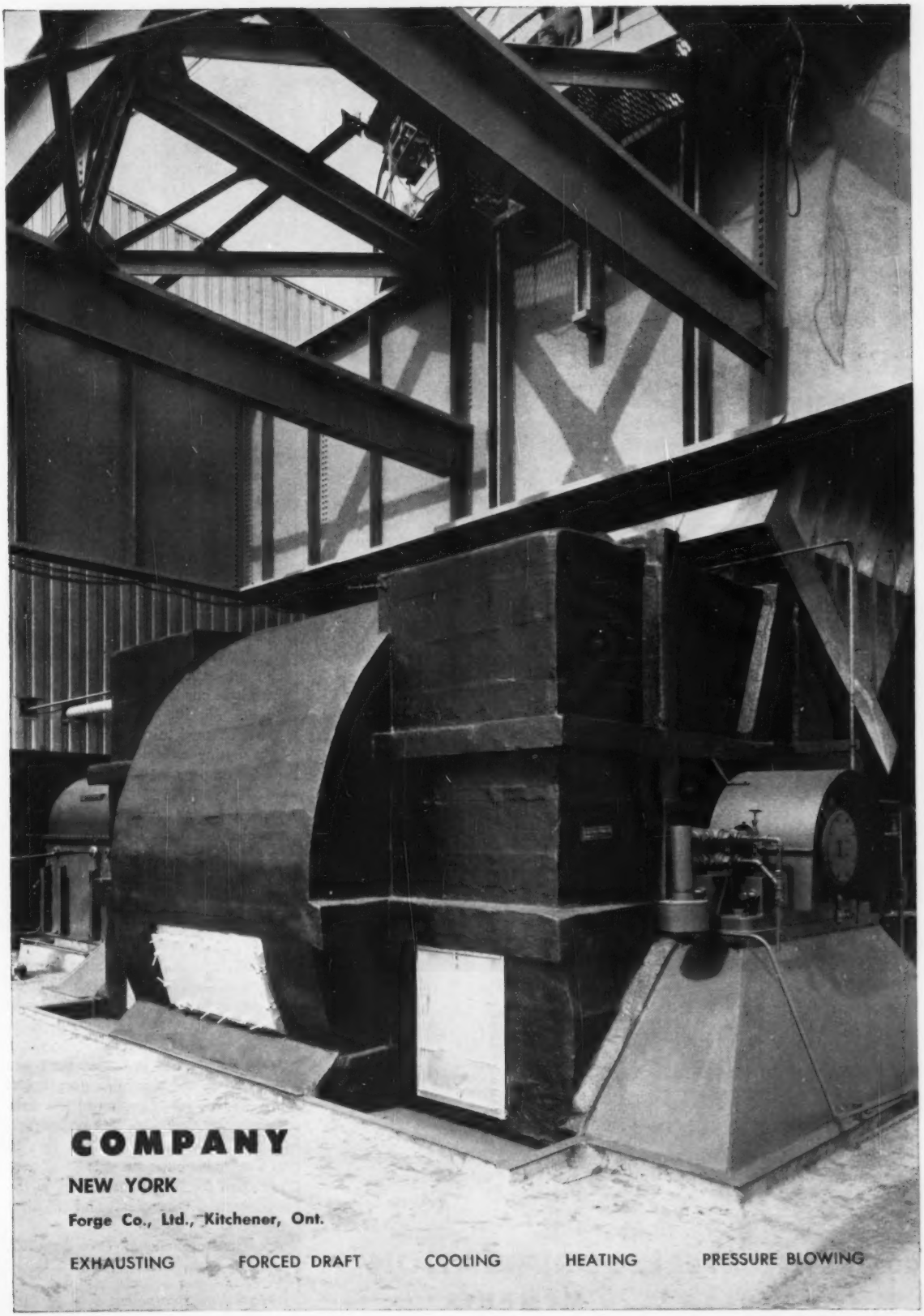
"Buffalo"

BUFFALO FORGE

BUFFALO,

Canadian Blower &

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT


COMPANY
NEW YORK
Forge Co., Ltd., Kitchener, Ont.
EXHAUSTING
FORCED DRAFT
COOLING
HEATING
PRESSURE BLOWING

FLINT CAN SUPPLY YOUR STEEL

Flint's engineering, fabrication, storage and distribution facilities involve more than 340,000 square feet of working space in two conveniently located plants.

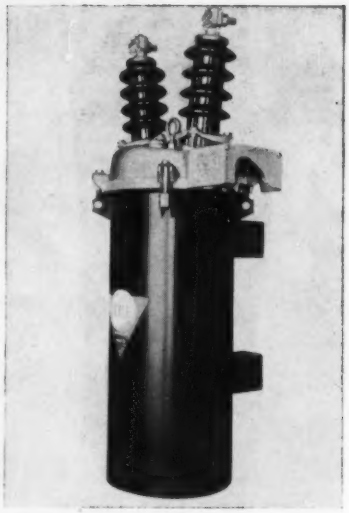
Service that's personalized and dependable—a modern and flexible operation that can be depended upon to deliver as specified.

STEEL WAREHOUSE DISTRIBUTORS
FABRICATED STRUCTURAL STEEL
FABRICATED STEEL PLATE
FABRICATED REINFORCING STEEL
FABRICATED GALVANIZED STEEL

for over 40 years

FLINT STEEL CORPORATION

TULSA . . . MEMPHIS



Single-Phase Recloser

An intermediate-duty oil circuit recloser is rated at 2.4 to 14.4 kv. Designated Type 4H, it is the single-phase counterpart to the manufacturer's Type 6H recloser. Type 4H is a power class recloser designed to supplement the H line of reclosers on systems requiring greater load and interrupting capacities.

It is said to be adaptable for pole and sub-station installation. Available with load current coil ratings of 5, 10, 15, 25, 35, 50, 70 and 100 amp, the 4H is claimed to provide a maximum interrupting capability of 3,000 symmetric amp or 4,200 asymmetric amp at 4.8 kv. BIL is 110 kv.

Line Material Co, 700 W. Michigan Street, Milwaukee 1, Wis.

Miniature Reactor

A miniature, low cost reactor, said to be small enough to fit into any school, industrial, or medical laboratory has been designed. The compact "Laboratory Reactor", is contained in a tank 8 ft high and 8 ft in diameter, and is priced at $55,000. It reportedly can be constructed and installed in existing laboratory buildings and be ready to run in less than six months. Operating at a power level of only 5 watts, the reactor is said to be able to provide sufficient radiation for important studies in the engineering, biological and medical fields.

Atomics International, P.O. Box 309, Canoga Park, Calif.

(*More New Equipment on page* 234)

The Case of WASTED HORSEPOWER

or

"Over-motoring" is outmoded by Dow Corning Silicones

SCENE: Pump room, Anyplant, U. S. A.

CHARACTERS: TINY H.—a 5 hp Class H motor insulated with Dow Corning Silicones. BLUSTER A. — a 7½ hp Class A motor.

TINY H: You're goofing-off again! Why don't you try moving a bigger load now and then?

BLUSTER A: Nuts to you, Tiny. I'm working hard enough keeping this little pump going.

TINY H: But you're strong enough to drive a bigger pump . . . or are you?

BLUSTER A: That's enough. I should worry—the engineers who put me here figured I might have to carry a 6 hp load—er—once in a while, at least.

TINY H: Sooo what! I'm rated to match our average load. My silicone insulated innards give me extra muscles to carry any overloads. Why—I could pump a 7 hp load and still be here when you're dead and gone.

BLUSTER A: Shut up, Tiny! Somebody might hear you.

TINY H: Okay, fat stuff, but you can't hide the facts forever. Mark my nameplate—one of these days the boss will figure out how much money you're wasting and you'll have had it.

You can match the load . . .
let Silicones carry the overload

Lazy motors cost money! Why continue to pay a fat premium for motors that make kid's play of their average work load? Today, you can save money by using silicone insulated motors rated to match your average load. Their built-in service factor of 25 to 50% will handle most intermittent overloads or loads that can't be matched in standard frame sizes.

Remember, over-motoring is outmoded

Get sources for silicone insulated equipment—mail coupon today

Dow Corning Corporation, Dept. 4410, Midland, Mich.

Please send me sources of supply for new Silicone (Class H) ☐ Motors ☐ Transformers

NAME _____ TITLE _____

COMPANY _____

STREET _____

CITY _____ ZONE ____ STATE _____

DOW CORNING SILICONES

DOW CORNING CORPORATION
MIDLAND, MICHIGAN

ATLANTA • BOSTON • CHICAGO • CLEVELAND • DALLAS
DETROIT • LOS ANGELES • NEW YORK • WASHINGTON, D. C.
(Silver Spring, Md.)

CANADA: Dow Corning Silicones Ltd., Toronto
GREAT BRITAIN: Midland Silicones Ltd., London
FRANCE: St. Gobain, Paris

You profit when people read "Skimpy Wiring" ads like this...

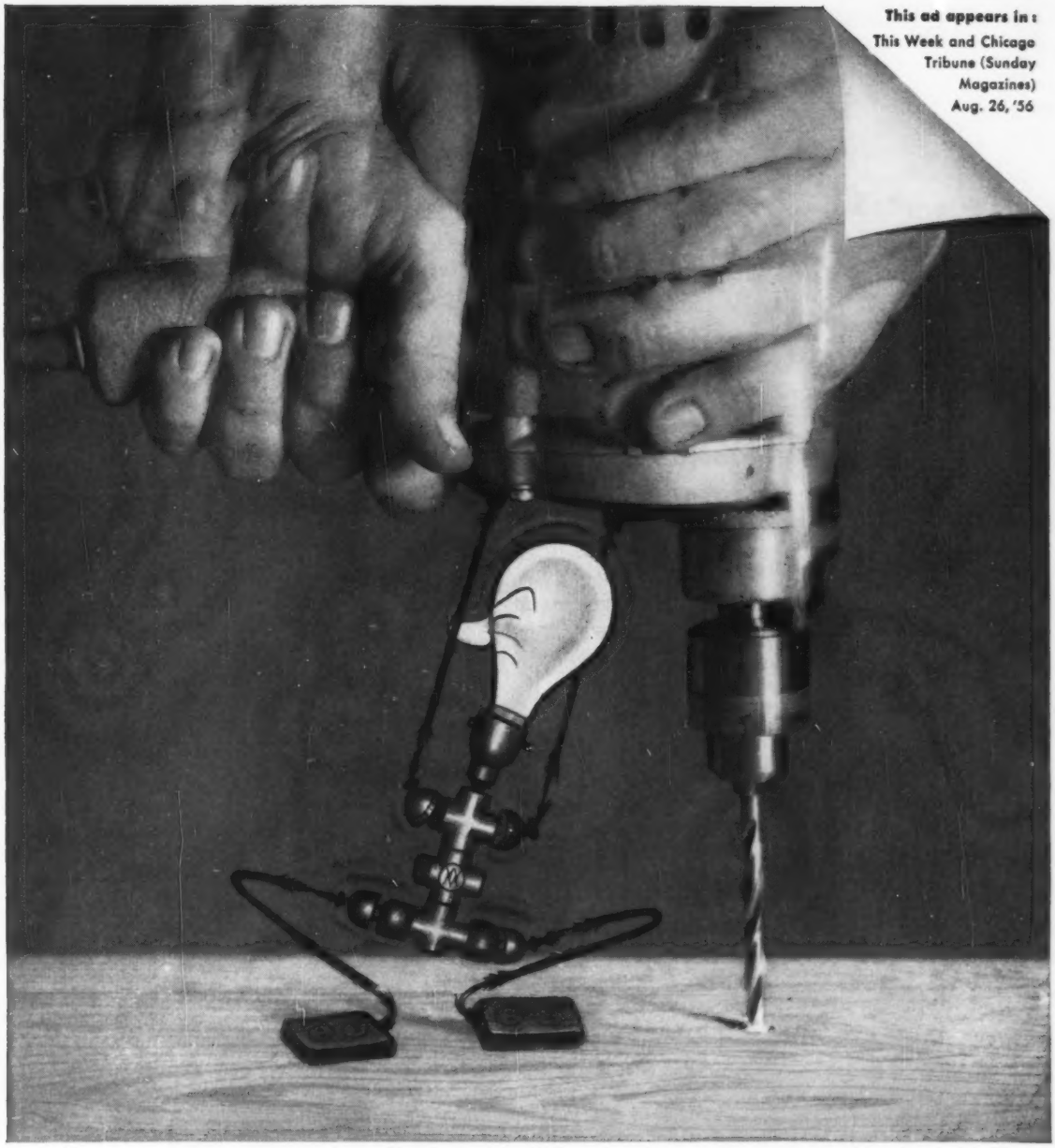
Kennecott's national campaign for better home wiring with copper *helps you increase your sales of power.*

Use this FREE material for your own better wiring promotions.

Send today for free reprints and poster-sized blowups of Kennecott's latest full-page national advertisements featuring "Skimpy Wiring." Get free copies of the educational booklet, "The ABC of Home Wiring." Ask for complimentary Home Wiring Wall Chart, mat service folder and list of at-cost prices of all material available. No cost, no obligation! Just write to Kennecott Copper Corporation, Dept. W96, 161 East 42nd St., New York 17, N.Y.

The Best Wiring is Copper!

This ad appears in:
This Week and Chicago Tribune (Sunday Magazines)
Aug. 26, '56



He makes slow work of do-it-yourself jobs!

Weak, undersized "Skimpy Wiring" actually holds back the electrical energy that gives muscle to motors. Don't expect new electric-drill bits or sharp circular-saw blades to speed your work if he is around. This current-stealing household pest can slow down and stall the finest power tools.

Find out how to rid your home of the many electrical ills symbolized by "Skimpy Wiring". Learn how easy it can be . . . how little it can cost . . . to give your home the full HOUSEPOWER of an *up-to-date copper wiring system.* Talk it over with your local power company or electrical contractor.

Get FREE Booklet! "The ABC of Home Wiring." It clearly explains important facts about your electricity and how you can make it serve you better. For your free copy, just write: Kennecott Copper Corporation, Department L96, Box 238, New York 46, New York.

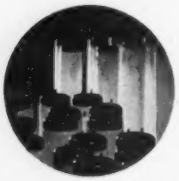
Kennecott Copper Corporation

Fabricating Subsidiaries: Chase Brass & Copper Co. • Kennecott Wire and Cable Co.

Ask these questions, too, when you judge a fluorescent lamp...

Is your investment protected?

Check Westinghouse Fluorescent Lamps against any other brands you are now using. Check them for maintained brightness, long life, uniform appearance. If you are not entirely satisfied on all counts, your full purchase price will be refunded.



Is it the correct type, size and color for the lighting job to be done?

In the Westinghouse fluorescent family of 290 different lamps—including Slimline and Rapid Start—there's a type and size precisely right for every office, plant and store application. Colors include seven different shades of "white" alone.

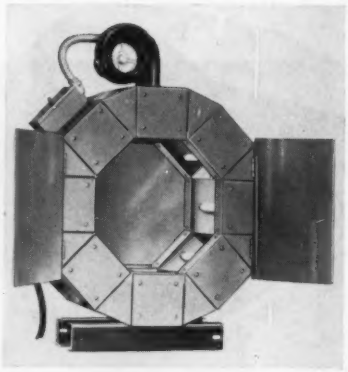
How about quality control?

From raw materials to finished product, every Westinghouse fluorescent lamp is subjected to *480 inspections and tests* before approval for shipment.

For the full story on how to get more for your money in fluorescent light, contact your Westinghouse Lamp Representative.

WATCH WESTINGHOUSE

WHERE BIG THINGS ARE HAPPENING FOR YOU!



Midget Infrared Oven

A small, inexpensive infrared oven is said to be meeting the needs of manufacturers for laboratory research and testing purposes. It is 16 in. deep with an opening of 13½ in., uses 12.8 kw at maximum operation, and provides a reflection factor of 97% in directing radiant energy to the material being tested. Oven temperatures of 1000 F at full intensity are reported. It is available as a complete unit, including switch, ventilation blower, lamps, and two hinged front doors.

Fosteria Pressed Steel Corp
Fosteria, Ohio

More New Products

General Electric Co, Detroit 32, Mich., announces a discharge **varistor** that is voltage sensitive and non-linear. It is designed for use in protecting motors, generators, solenoids, etc, and is said to be suitably mounted for direct installation in electrical circuits.

Walker Brothers, of Conshohocken, Pa., offer a **large capacity duct,** designated No. 4, which measures 1½ in. high by 6½ in. wide and has an interior cross sectional area of 8.75 sq in.

Lug-All Co, Haverford, Pa., has a lightweight 1½-ton capacity **ratchet lever hoist** with a standard lift of 30 ft. This is said to make it ideal for long pulls and lifts, since it eliminates the need for any staging.

Steber Mfg Co, Broadview, Ill., have made available 2- and 3-lamp **cluster spike units** for sealed beam lamp spot or floodlighting. The ground spike is cast aluminum, with adjustable lamp holders attached.

General Electric Co, Schnectady, N. Y., has a permanent split-capacitor **fan motor** designed for small, compact room and console air conditioners. It is available in ratings from 35 mhp to 1/6 hp, and reportedly simplifies application problems of air conditioner manufacturers.

Federal Telephone & Radio Co, Clifton, N. J., has added another line of **selenium rectifiers** for use with fast battery chargers for automobiles. The new rectifiers reportedly serve all charging requirements for 6 or 12-volt batteries over a current range from 30 to 100 amp dc.

Technique Associates, Inc, 211 E. South Street, Indianapolis 25, Ind., have announced a portable potentiometer **pyrometer** for calibrating all types of industrial and laboratory temperature instruments. The "Pyrotest 9B" has a reported temperature range of between 32 and 3215 F.

Chicago Industrial Instrument Co, 865 N. Sangamon Street, Chicago 22, Ill., recently announced a portable **ohmmeter** which is said to be capable of measuring extremely small values of resistance. Designated Model 555 Centi-Low Ohmmeter, it is used for detecting shorted windings and other low-resistance circuit troubles.

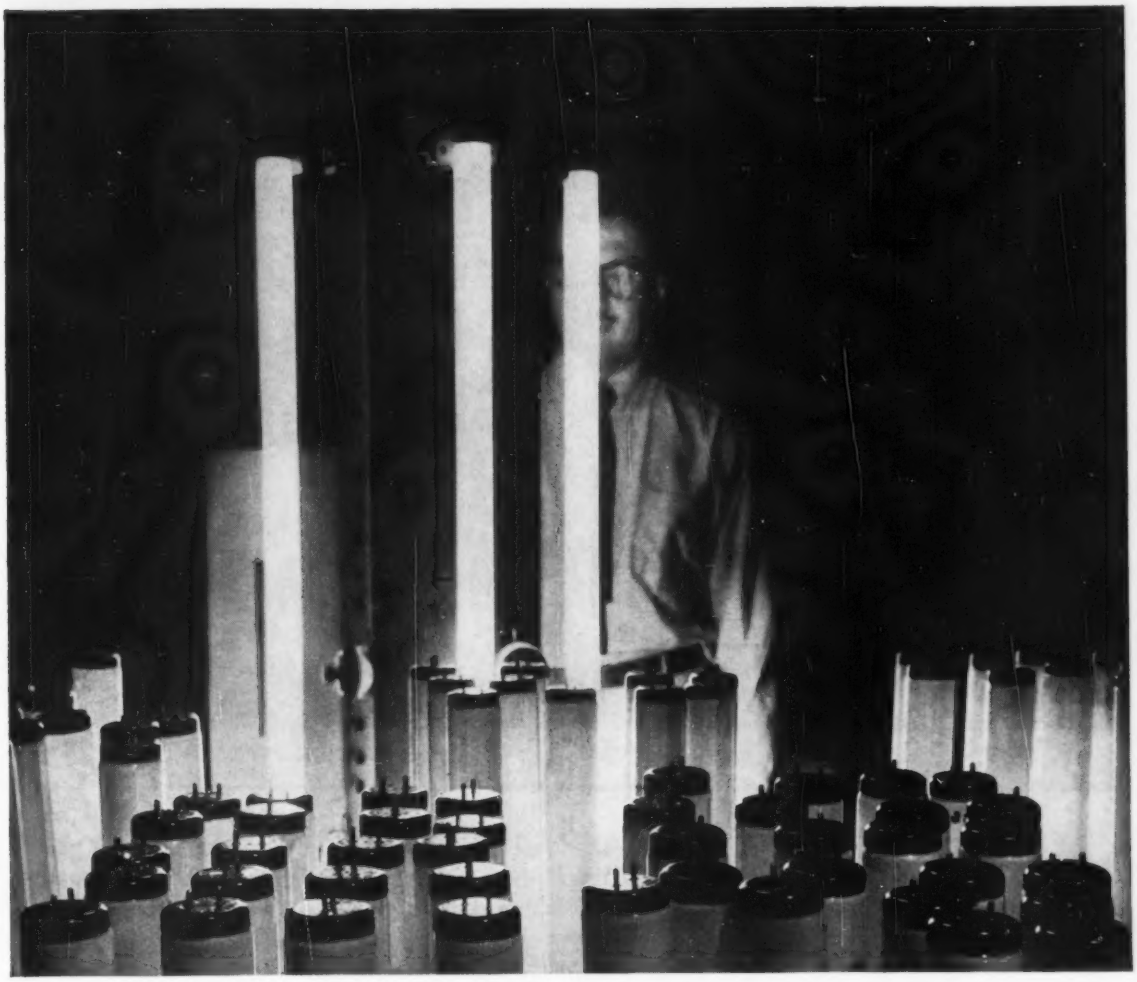
Westinghouse Electric Corp, Pittsburgh 30, Pa., have made available two new models of "West-ing-arc" **welding equipment,** the SA-40 and the SA-40A. Both are said to be readily useable for CO_2 or submerged operation. Both air cooled, the welding heads are said to be capable of driving wire diameters from 5/64 to ¼ in. at speeds up to 300 in. per minute.

General Electric Co, Schenectady 5, N. Y., announces ac and dc small-diameter **tachometer generators** for speed measuring and regulation applications.

Robertshaw-Fulton Controls Co, 2920 N. Fourth Street, Philadelphia 33, Pa., offers a **capacity telemeter** that reportedly can be used to measure the level in storage tanks and bins located more than ¾ mile away.

(*Continued on page* 238)

how to judge a fluorescent lamp . . . point no. 8



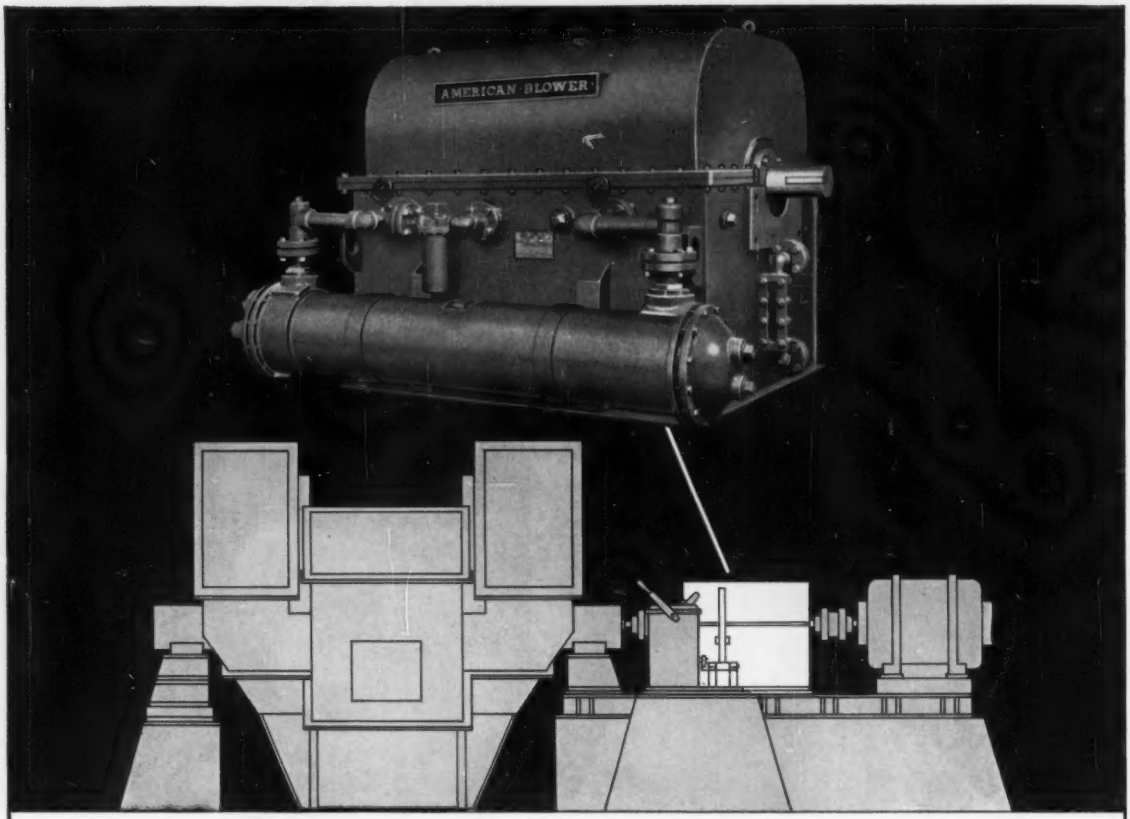
ask about COLOR MATCH

You can be sure that the Westinghouse fluorescent lamp you buy today will exactly match the Westinghouse lamp of the same color classification you bought yesterday or years ago. Two facts guarantee it. *First*, to insure strictest uniformity, Westinghouse makes all of its own lamp phosphors, the tube-coating materials that determine lamp color. *Second*, Westinghouse (and only Westinghouse) uses "drift-free," *Halo-type* Phosphors throughout its entire fluorescent lamp line.

WATCH WESTINGHOUSE

*WHERE **BIG** THINGS ARE HAPPENING FOR **YOU!***

The tougher the duty, the more

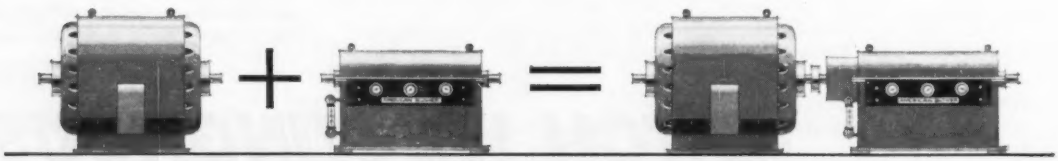


Mechanical Draft Fan Gýrol Fluid Drive Motor

LARGER MECHANICAL DRAFT FANS — Gýrol Fluid Drive gives you the kind of accurate, efficient control of mechanical draft that results in important power savings, longer equipment life. The reason: Fluid Drive's infinitely adjustable speed control, which enables each fan to operate at its optimum design or selection point.

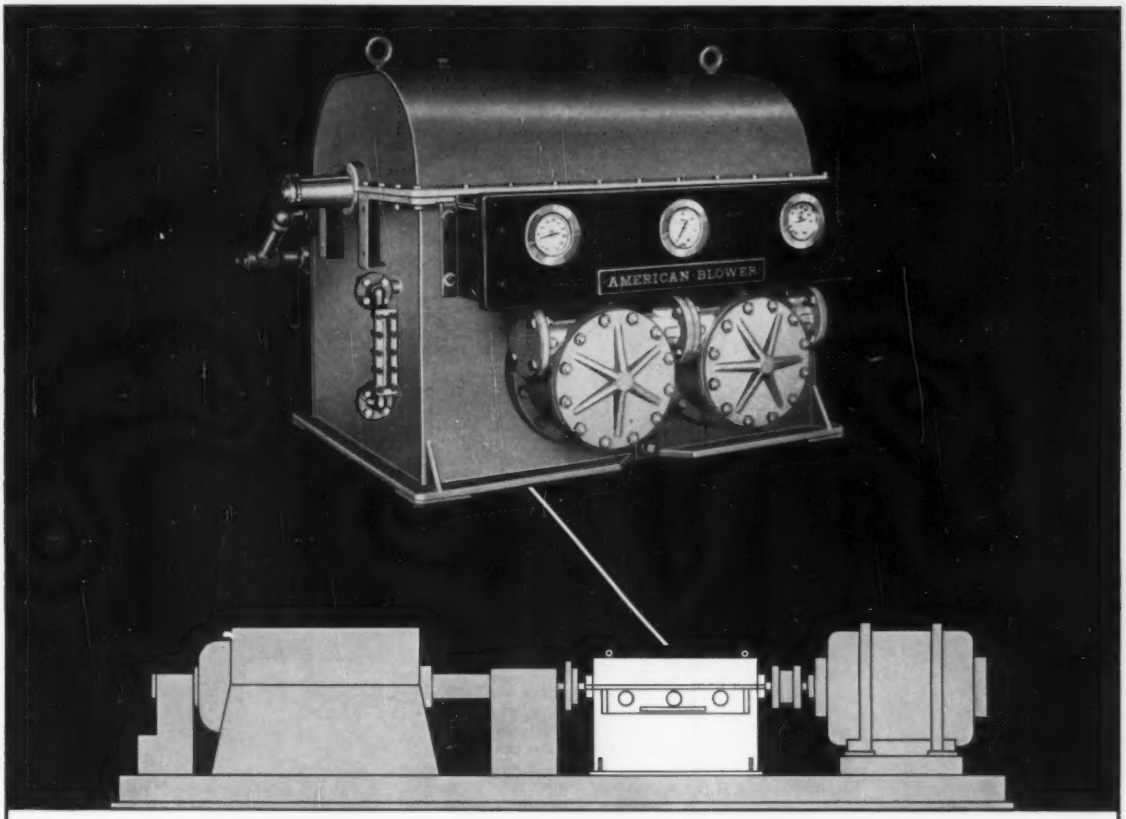
This adjustable-speed feature saves horsepower, gives good, stable volume and pressure control over the operating range . . . simplifies motor-starting equipment . . . reduces damaging high- and long-duration inrush currents on the motors . . . provides no-load starting of high WR^2s that exist in the new, high-volume, high-pressure fan wheels.

What's more, it prolongs life of fan bearings; reduces fly-ash abrasion on fan wheel, fan scroll, inlet boxes, and breeching connections. When you add to these advantages the reduction in noise level, it becomes increasingly clear that the tougher the duty, the more you need Gýrol Fluid Drive for control of mechanical draft.



Rugged constant-speed induction motor American Blower Gýrol Fluid Drive Smooth, adjustable-speed control

you need Gýrol® Fluid Drive



Boiler Feed Pump | Gýrol Fluid Drive | Motor

LARGER BOILER FEED PUMPS — As larger boiler feed pumps are built, there is a greater need for higher efficiencies and more accurate control. That's why more and more consulting and utility engineers are recommending Gýrol Fluid Drive.

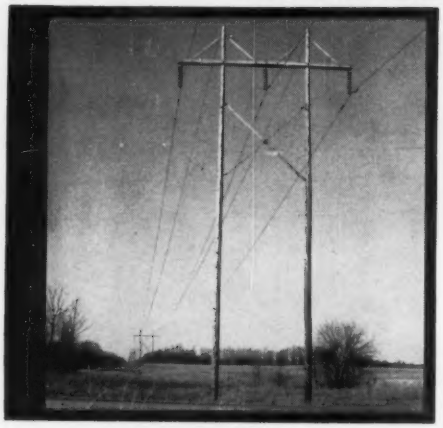
You see, Gýrol Fluid Drive offers adjustable-speed pump control that saves power over the entire operating range by eliminating wasteful throttling. Then, too, Fluid Drive reduces wear on bearings and other vital parts by operating the pump at speeds that fit boiler demands. Paralleling of pumps is simplified. And emergency changeover from operating to standby pump is fast and foolproof—there's no need for boiler shutdown.

If your plant expansion calls for boiler feed pump control, it will pay you to talk to an American Blower engineer. He can show you where Gýrol Fluid Drive can save power, cut costs, give you a more efficient operation. Contact our nearest branch office, or write us direct. American Blower Corporation, Detroit 32, Michigan. In Canada: Canadian Sirocco Company, Ltd., Windsor, Ontario.

AMERICAN BLOWER

Division of AMERICAN-Standard

GALVANIZED STEEL STRAND

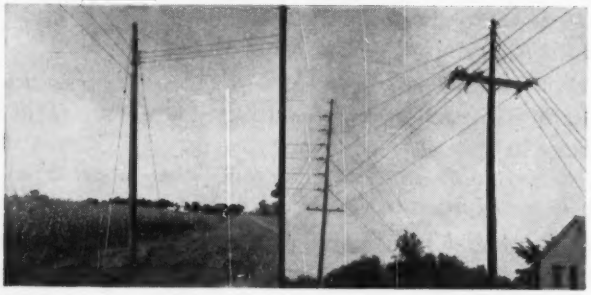


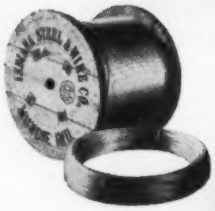
YOUR ASSURANCE OF HIGH QUALITY, LONG LIFE AND LOW COST

Close laboratory control over each step in manufacture has established Crapo Galvanized Steel Strand as a product of highest quality and dependability. You benefit through longer service life and lower ultimate costs.

Heavy, uniform, tightly-bonded coatings of commercially pure zinc, applied by the famous Crapo methods, withstand the punishment of construction, provide maximum resistance to corrosion and contribute to over-all economies.

For OVERHEAD GROUND WIRE . . .
CRAPO Weldless Galvanized Steel Strand





The most practical and economical strand for shielding transmission lines against lightning. Maximum strength and high fatigue endurance, inherent in Crapo Weldless Strand, provide that extra safety factor so important in overhead ground or static wire.

For GUYS and MESSENGER . . .
Crapo Galvanized Steel Strand. Made to highest standard specifications . . . a size and breaking strength to meet all practical needs.

Contact your jobber or write for descriptive folder.

INDIANA STEEL & WIRE CO., INC.
Muncie, Indiana

More New Products

(*Continued from page* 234)

Its accuracy is claimed to be unaffected by weather conditions or electrical properties of the connecting coaxial cable.

Fischer & Porter Co, 809 Jacksonville Road, Hatboro, Pa., have made their **analog-to-digital converter,** the Digi-Coder, available in a C-2-B model. Some of the advantages of the new model are said to be lower cost, reduced inertia, a wide range of ac and dc operating voltage, and noncorrosive, precious-metal contacts.

CATALOGS—BULLETINS

• **ELECTRICAL TAPES:** A brochure describes the qualities and applications of vinyl plastic electrical pressure-sensitive tapes with emphasis on the causes of insulation failure. Permacel Tape Corp, New Brunswick, N. J.

• **DC MOTORS:** Bulletin designated 53B8424 describes dc motor motors, ½ to 200 hp, and motor-generator sets up through 200 kw. The bulletin also covers shunt and stabilized shunt wound, compound wound and series wound motors plus matching motor-generator sets for conversion of ac to dc. Allis-Chalmers Mfg. Co., 932 S. 70 Street, Milwaukee, Wis.

• **AC MOTORS:** A bulletin devoted to large 2-pole squirrel-cage induction motors, 900 hp and larger, is available on request. Motors covered are said to be particularly adaptable to boiler feed pumps, pipeline pumps, centrifugal blowers, etc. No. 05B8123A, write Allis-Chalmers Mfg Co, 932 S. 70 Street, Milwaukee, Wis.

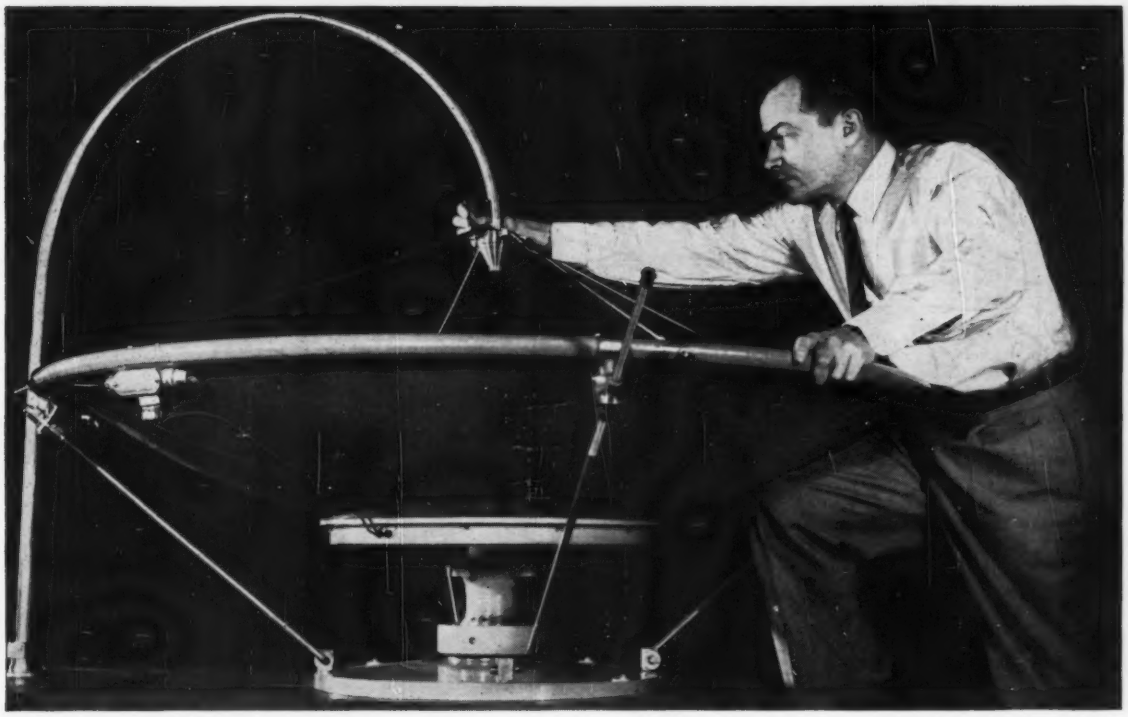
• **SILICONE COMPOUNDS:** A four-page pamphlet, designated AD 24E, listing the major categories of silicone compounds and the typical properties of each has been prepared. It includes cross references to AMS and ASTM specifications. A more detailed description of silicone rubber and its applications is contained in a 24-page publication, "Imagineering with Silicone Rubber". Both may be obtained by writing General Electric Co, Silicone Products Dept, Waterford, N. Y.

• **BATCH CONTROL:** A catalogue giving an account of batch control systems. These systems are said to offer a simple, dependable means for automatically adding a predetermined volume of fluid to a batch process. Ask for Catalog 91-109, Fischer & Porter Co, Hatboro, Pa.

• **POLYETHYLENE PIPE:** Eight-page bulletin CE-57, outlines standard flexible polyethylene pipe sizes and fittings, installation instructions, flow rates, and specifies which of the common industrial liquids may be carried in it. American Hard Rubber Co, 93 Worth St, New York 13, N. Y.

(*More Catalogs on page* 242)

TEACHING A GIANT TO TAKE SHORT STEPS



Bell Laboratories' Dr. J. W. Fitzwilliam adjusts a waveguide feed to a parabolic dish reflector. Dr. Fitzwilliam, who has a Ph.D. in physics from Massachusetts Institute of Technology, leads the practical development of Bell's new 11,000-mc. system. Components had to be developed to operate in a frequency band not previously utilized.

The giant microwave highway that carries your TV programs along with telephone conversations from coast to coast has a versatile new partner — an entirely new microwave system which was created, and is now being developed, at Bell Laboratories. The new system operates at 11,000 megacycles — a much higher frequency than ever before used in telephone service.

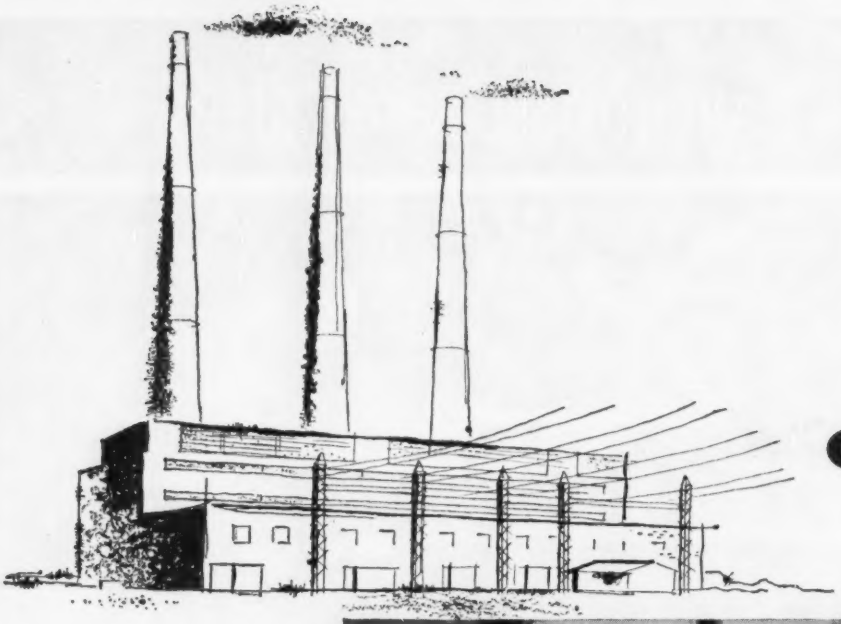
Bell's present microwave systems — operating at 4000 megacycles — were designed for heavy traffic and long distances. The new system is designed especially for lighter traffic and shorter distances—up to 200 miles. Its traffic capacity is extremely flexible. Depending on traffic needs, the system can provide only one one-way or as many as three two-way broadband channels. Each two-way channel can carry 200 telephone conversations simultaneously or one television program in color or black and white in each direction along a route. The new microwave system, which is already being operated experimentally, will be valuable in providing additional telephone service and television programs for cities in remote areas.

This is another example of how research and development work at Bell Telephone Laboratories help the Bell Telephone System to serve you better.

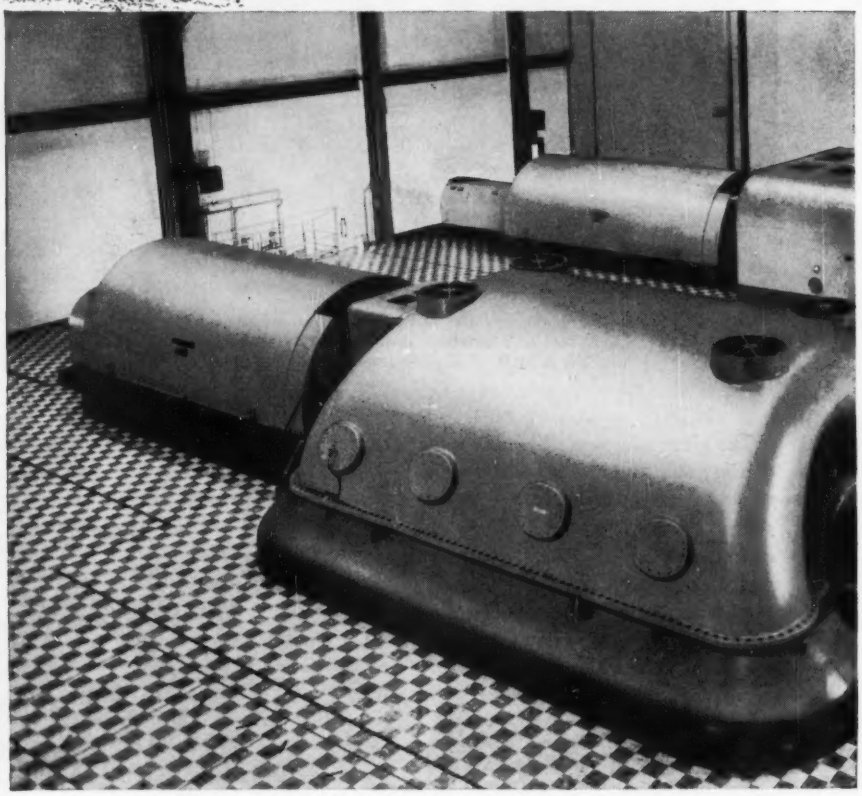
Mr. L. C. Tillotson, who originated the new system, adjusts the klystron-isolator combination which made the system feasible. Mr. Tillotson, an M.S. from the University of Missouri, is in charge of research in microwave applications.

BELL TELEPHONE LABORATORIES

WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT



OVEC's

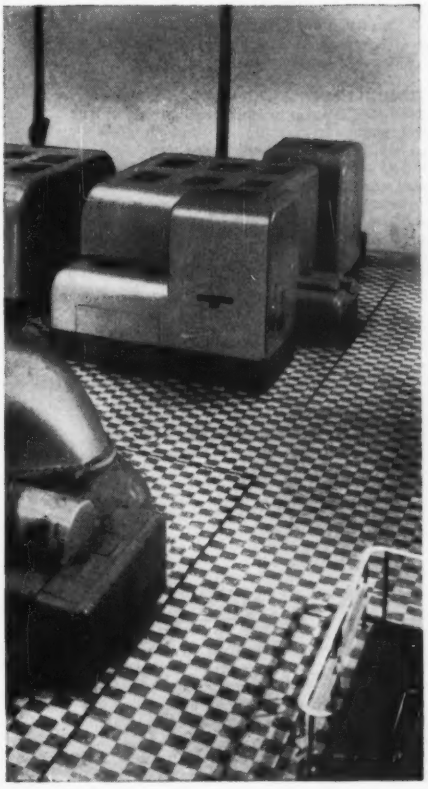


OVEC IS OWNED BY THE FOLLOWING PRIVATE ELECTRIC UTILITIES:

Appalachian Electric Power Company* • The Cincinnati Gas & Electric Company
Columbus and Southern Ohio Electric Company • The Dayton Power and Light Company
Indiana & Michigan Electric Company* • Kentucky Utilities Company
Louisville Gas and Electric Company • Monongahela Power Company** • Ohio Edison Company
Ohio Power Company* • Pennsylvania Power Company*** • The Potomac Edison Company**
Southern Indiana Gas and Electric Company • The Toledo Edison Company • West Penn Power Company**

*Subsidiary of American Gas and Electric Co. **Subsidiary of The West Penn Electric Co. ***Subsidiary of Ohio Edison Co.

Kyger Creek Station



...best heat rate in the nation for 1955!

In the fast-moving race to higher and higher station efficiencies, Kyger Creek Plant of the Ohio Valley Electric Corporation placed first for the year 1955 according to figures released by the Federal Power Commission. The official rate was 9110 btu/kwhr.

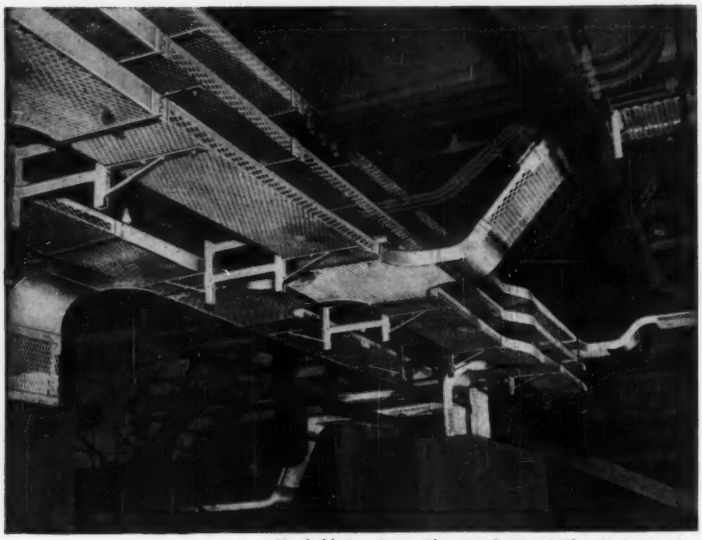
Four of the five Kyger Creek turbine-generators are Westinghouse cross compound, double flow, rated 217,260 kw.

J-50591

WATCH WESTINGHOUSE!

*WHERE **BIG** THINGS ARE HAPPENING FOR **YOU!***

P.G.&E. Uses Cope Cable Trough

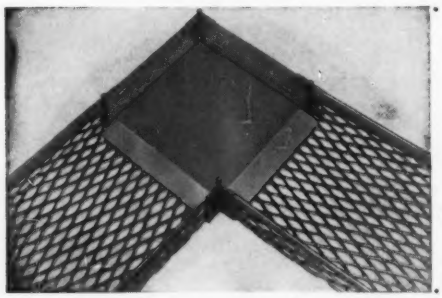


Humboldt Bay Steam Plant Pacific Gas & Electric Corporation
Engineers: Bechtel Corporation

Pacific Gas and Electric installed Cope cable trough for its latest installations in new generating stations. Efficient utilities everywhere are adopting Cope cable trough to eliminate costly and needless conduit.

Cope cable trough saves three ways:

- *Materials* are reduced by 75% on a lineal foot basis
- *Installation costs* are reduced because cable trough is so easy to install
- *Operating costs* are reduced because accessible cable is simple to inspect, repair or replace and additions are simply laid in existing trough.



New Cope 70,000 Series features unique flexibility in elbows— reduces the need for standard fittings.

Our engineers are ready to work with you. Write us today for full details on Cope Cable Supporting Systems.

T. J. COPE, INC.

COLLEGEVILLE 4, PENNSYLVANIA

Cope

GROUND TENTS

ROD GRAPPLES

CABLE REEL JACKS

WARNING SIGNS

CROSS ARM SHEAVES

Catalogs—Bulletins

(*Continued from page* 238)

● **ELECTROPLATING:** "Industrial Precision Electroplating," gives an outline of the growth of the electroplating industry, the publishing firm's contribution to it, and the requirements of specific industries, such as electronic, electrical, aircraft, etc. The Summit Co, Thomaston, Conn.

● **ISOLATED PHASE BUSES:** A 20-page bulletin, designated GEA-5460A, contains descriptive, application and dimensional information pertaining to unit supported isolated phase buses. Available from General Electric Co, Schenectady 5, N. Y.

● **NOICE CONTROL:** "So You Want to Increase Production" is the name of an 8-page bulletin summarizing the benefits to be obtained from noise and vibration control in the way of increased efficiency, space utilization, less absenteeism, etc. Korfund Co, 48-21H 32 Place, Long Island City 1, N. Y.

● **D C MOTORS:** A non-promotional booklet entitled, "Why D C," intended to answer the laymen's questions about D C's alleged obsolescence in easy, understandable, non-technical terms has been published by General Electric Co, D C Motor & Generator Department, Erie, Pa.

● **CIRCUIT BREAKERS:** Three bulletins: No. 5042 provides descriptive and application information on the complete line of Cordon circuit breakers; No. 3004-A contains technical information about the FB line of high speed, current limiting dc circuit breakers; No. 1004-A describes the I-T-E-K line of circuit breakers plus information on heavy duty dc circuit breakers. Write I-T-E Circuit Breaker Co, 19th and Hamilton Streets, Philadelphia 30, Pa.

● **RESISTANCE WELDING:** Volume 4, No. 7 of "Resistance Welding at Work", covering the use of resistance welding techniques to fabricate miter joint aluminum window frames is now available. Advantages listed include increased production and decreased manufacturing cost and labor demand. Write Sciaky Bros, Inc, 4915 W. 67 Street, Chicago, Ill.

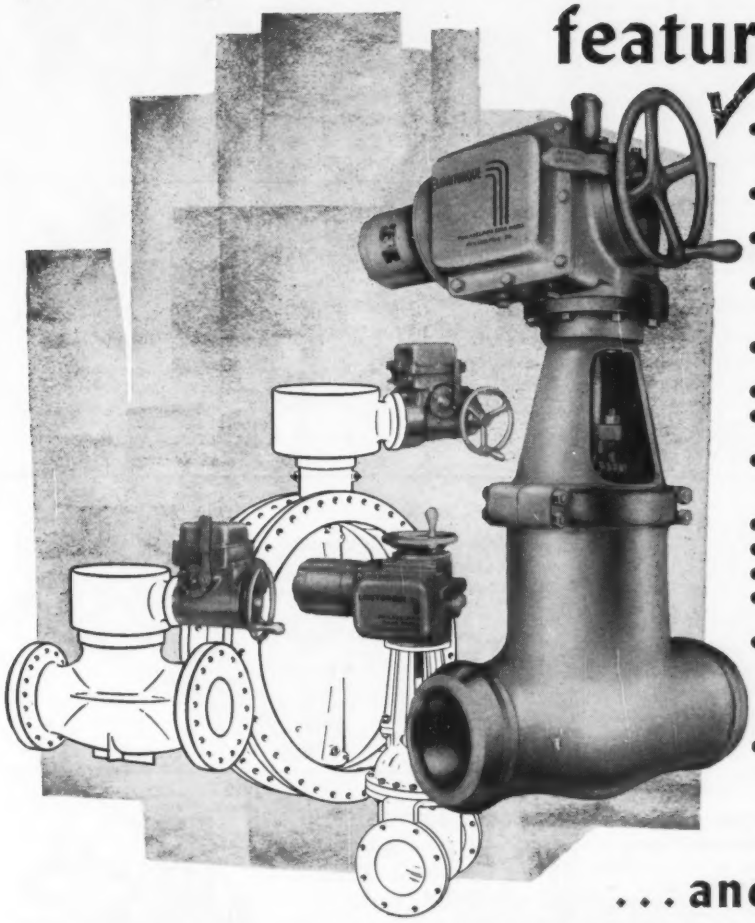
TECHNICAL LITERATURE

LIGHTING CALCULATIONS—An entirely new and more accurate method for making lighting calculations necessitated by the introduction of ceilings of over 80% reflectance (as compared to older ones of 75%) is discussed by the I. E. S. Committee on Lighting Design Practice in its new report entitled, "Calculating Coefficients of Utilization." The new method is a departure from the "Lumen Method," adopted in 1920. In addition to explaining the basic method, the report includes complete work sheets with step-by-step instructions for their use. Price, 50¢ each, quantity prices on request. Complete sets of work sheets are available at 5¢ each. Write Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y. Att: Publications Office.

(More Tech. Literature on page 246)

See the newest developments in Mechanical Power Transmission at our Booth #80 22nd National Power Show, New Coliseum, New York City, November 26-30.

Check these features



- Micrometer torque seating switch gives tight valve closure, and protects valve parts from damage.
- Self contained unit—no gears, stem nut or bearings to buy.
- Weatherproof, dust-tight, watertight and explosion-proof construction.
- Hammerblow device . . . allows motor to reach full speed, before load is engaged.
- Non-rotating handwheel built into the unit.
- Automatic declutching.
- Motor is disengaged during handwheel operation.
- Can always be declutched for handwheel operation regardless of weather or electrical conditions.
- High torque motors.
- Simple valve yoke.
- May be mounted in any position.
- Three to four times faster handwheel operation.
- Actuation may be by any available power source such as electricity, air, oil, gas, water or steam. LimiTorque is readily adapted for microwave control.
- LimiTorque is designed for plug, butterfly, gate and globe valves up to 96″ diameter . . . Entire Unit and nut can be lifted off valve yoke, by removing flange bolts.

. . . and you'll understand why more *LIMITORQUE* valve controls are in use than all others combined

Send for new catalog L-550, and please use your Business Letterhead when requesting.

LimiTorque®

PHILADELPHIA GEAR WORKS, INC.
ERIE AVE. & G STREET. PHILADELPHIA 34, PENNA.
Offices in all Principal Cities

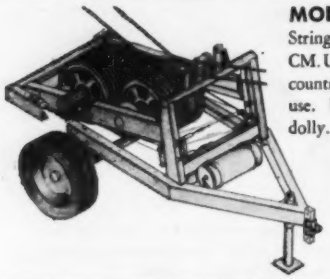
INDUSTRIAL GEARS & SPEED REDUCERS • LIMITORQUE VALVE CONTROLS • FLUID MIXERS • FLEXIBLE COUPLINGS

Limitorque Corporation • Philadelphia

Partial showing of the now ***COMPLETE*** line of . . .

PENGO TENSION WIRE STRINGING EQUIPMENT

Manufactured By **PETERSEN ENGINEERING CO., *Santa Clara, Calif.***

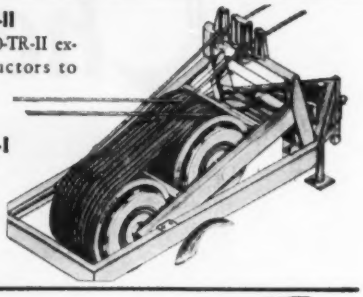


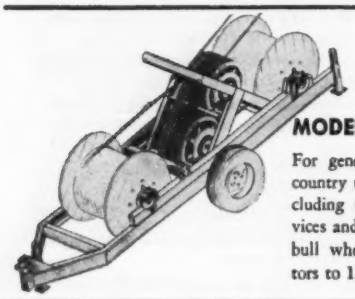
MODEL 5000-TR-II
Strings two conductors to 556,300 CM. Used primarily for very rough country work; also for general use. Use separate reel-carrying dolly.

MODEL 5000-TR-I
Similar except strings one conductor.

MODEL 6000-TR-II
Similar to Model 5000-TR-II except larger. Conductors to 1,272,000 CM.

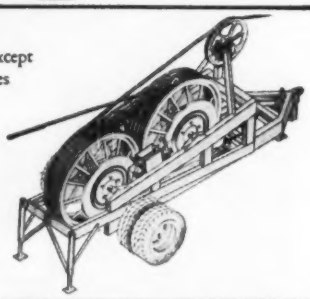
MODEL 6000-TR-I
Similar except for one conductor.

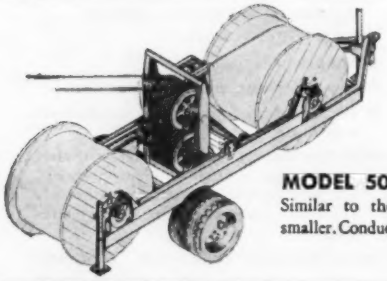




MODEL 6000-WS-TR
For general and medium rough country use. A complete unit including trailer, reel-carrying devices and its own double pair of bull wheels. Conductors to 1,272,000 CM.

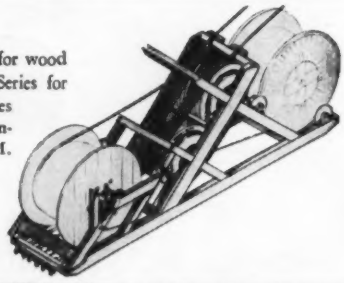
MODEL 7000-TR-I
Similar to model 6000-TR-I except larger. Conductors to 2 inches diameter.

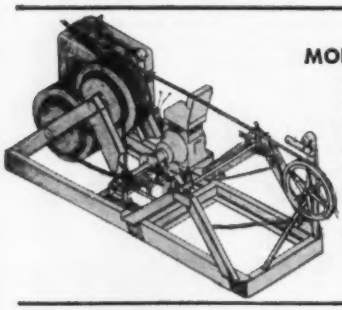




MODEL 5000-WS-TR
Similar to the 6000-WS-TR but smaller. Conductors to 556,300 CM.

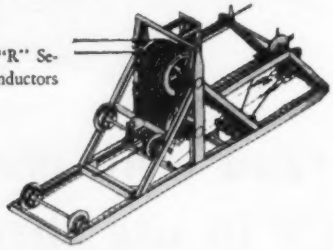
MODEL 6000-W
Available in "S" Series for wood or steel reels, in "R" Series for steel reels, or "SR" Series for trailer mounting. Conductors to 1,272,000 CM.

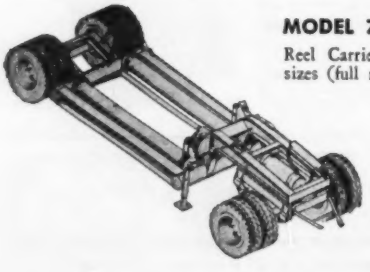




MODEL 6500
Bull Wheel Cable Puller. Available in "R" Series for steel reels, "S" Series for wood reels. Conductors to 1,272,000 CM. Also available in "LWR" Model for extra-large steel reels. Model 5500 similar (smaller).

MODEL 5000-SR
Available in "S" Series, "R" Series, or "SR" Series. Conductors to 556,300 CM.





MODEL 7500
Reel Carrier. Takes the largest sizes (full range) of steel reels. Loads and unloads with one man. No auxiliary equipment needed except the truck that pulls it. For use with any one of the tensioning machines shown on this page.

ADDITIONAL MODELS NOT SHOWN

Tension Reel Trailers

MODELS 2, 3, and 4, Two-Wheel Straddle Dollies not shown. For use with any one of the tensioning machines shown on these pages.

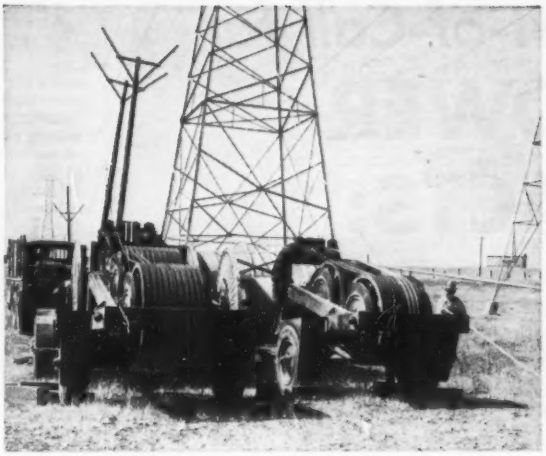
Tension Stringers

MODELS 6000-SK-I and 6000-SK-II For one or two conductors to 1,272,000 CM. Skid mounted for installation on owner's equipment.

MODELS 5000-SK-I and 5000-SK-II Skid mounted for installing on owner's equipment. For stringing one or two conductors to 556,300 CM.

MODEL 5000-WS-III Strings three conductors to 556,300 CM. For mounting on low-bed or full trailer.

MODEL 6000-WS-III Strings three conductors to 1,272,000 CM. For mounting on low-bed or full trailer.



Two PENGO model 6000 TR-II wire tensioners being used by Pacific Gas and Electric Co. in reconductoring job between Vacaville, Calif. and Cottonwood, Calif. 285 miles of 500 MCM copper is being replaced by 954 MCM aluminum in this operation.

Newest method of stringing overhead lines

Two PENGO model 6500 Bullwheel Cable Pullers used by Pacific Gas and Electric Co. for pulling in the new line on the job mentioned above. Unit, manned by an operator and one reel tender, pulls the pulling line (in this instance the old copper conductor) over the double neoprene lined Bullwheels and winds it for shipment in a single operation.

- ***Safest, most economical way of stringing transmission, distribution and even secondary lines.***
- ***Its greatest savings are effected when stringing over and through energized circuits . . . by far the safest, too!***

Smooth, postive control of conductor tension can be maintained at all times regardless of model or size of PENGO tensioning equipment used. The large, specially designed PENGO disc brakes are mounted away from the Bullwheels to assure dissipation of the heat generated by the continuous braking action and prevent transmission of the heat to the Bullwheels.

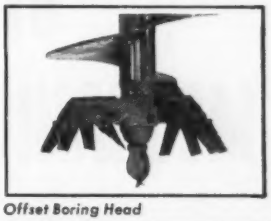
Note the wide range of models on the opposite page available for all types of jobs or terrain and for all sizes of conductor.

List your requirements and send for descriptive literature and prices.

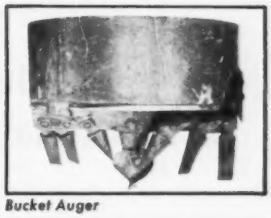
Other PENGO Products include:

24 inch Heavy Duty Flight Auger

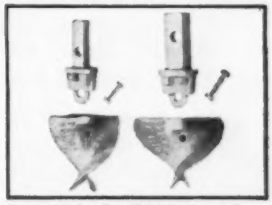
Double-Helix Heavy Duty Auger



Offset Boring Head

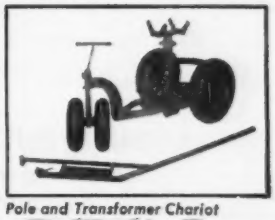


Bucket Auger



Screw Bit for Small Diameter Holes

Pulling Eye



Pole and Transformer Chariot

Made by the makers of the World-Famous
PENGO EARTH AUGERS

PETERSEN
ENGINEERING COMPANY
Santa Clara, Calif.

PETERSEN ENGINEERING CO.
Santa Clara, California **Dept. 4**
Please send me more information on the new Pengo wire stringing equipment.
Name_____
Firm_____
Address_____
City_____ State_____

Best Port-of-Call for POWER FACTS:

22nd NATIONAL EXPOSITION of POWER & MECHANICAL ENGINEERING

Under auspices of ASME

NOV. 26-30, 1956—
in NEW YORK'S beautiful new COLISEUM

If your interest is in the efficient production—or use—of POWER of any kind, you should make a date to see the Power Show in November!

This bigger, better exposition features hundreds of informative exhibits of new equipment, new techniques, new applications . . . and ATOMIC ENERGY is covered in a special section!

Engineers, production men, executives all profit when they take time out to attend . . . just *one valuable idea* that is gained here may mean the difference between next year's profit and loss. Your visit is really an investment in the future!

And what a pleasant investment it is! Never before have you attended an exposition in such a modern, convenient, exhibition hall. What's more, the COLISEUM is only 4 minutes from the entertainment center of the world!

PLAN NOW to come, and to bring your key men. SAVE TIME by writing today for free advance registration to

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22nd NATIONAL EXPOSITION of POWER & MECHANICAL ENGINEERING
480 Lexington Ave., New York 17, N. Y.
Management: INTERNATIONAL EXPOSITION COMPANY

TECHNICAL LITERATURE

(*Continued from page* 242)

IMPACT TESTING—"Symposium on Impact Testing", ASTM Special Technical Bulletin No. 176, consists of a number of papers on the effect of shock and impact on various materials. Recent innovations in this field, such as the impact tube are discussed and environmental conditions, particularly temperature, are considered. Tests for parts, components, and complete structures are covered. 170 Pages, price $3.50. Write American Society for Testing Materials, 1916 Race Street, Philadelphia, Pa.

RUBBER PRODUCTS—Every American Society for Testing Materials' standard relating to rubber and related products is included in "ASTM Standards on Rubber Products, With Related Information". This 746-page, paper cover volume is sponsored by ASTM Committee D-11 on Rubber and Rubber Products, and is convenient for laboratory use and for reference work. The volume contains 158 standards in their latest forms—91 methods of tests, 38 specifications, 23 recommended procedures, and 6 definitions. Included are processibility tests, chemical and physical tests for vulcanized rubber, aging and weathering tests, and low temperature tests. Standards for electrical protective equipment, tape, rubber-coated fabrics, and insulated wire and cable. Price, $5.75. Write American Society for Testing Materials, 1916 Race Street, Pa.

EDUCATION—Data on the number of students assisted by the Federal Government on the undergraduate, graduate, and post-graduate levels in the sciences, is contained in "Federal Support for Science Students in Higher Education," published by the National Science Foundation. Price, 30¢. Write Superintendent of Documents, Washington 25, D. C.

POWDER METALLURGY—The Powder Metal Association recently released the Proceedings of the 1956 Annual Meeting. The 130-page book contains several technical papers, of which the following might be particularly interesting: "Application of Powder Metallurgy to Nuclear Engineering," by H. H. Hauser; "Powder Metallurgy in the Electrical and Electronic Industries," by A. S. Doty; and "Aluminum Powder Metallurgy Products," by J. P. Lyle, Jr. Available at $3.00 a copy from Metal Power Association, 130 W. 42 Street, New York 36, N. Y.

AIR CONDITIONING—A complete revision of an air conditioning engineering application standard issued in 1947 by the Air Conditioning and Refrigerating Machinery Association is now available. The new document, designated ARI Standard 530, concerns itself with multizoned buildings such as factories, office buildings, and similar structures in which varying degrees of cooling and humidity must be maintained. Factors and phases of estimating loads and setting performance specifications include: design factors, sensible heat gain through glass, transmission, heat gain from occupants, heat gain from appliances, ventilation and infiltration, air motion in conditioned spaces, capacity specifications, cooling load calculations and safety provisions. The booklet is issued at no charge by the successor to ACRMA, the Air Conditioning & Refrigeration Institute, 1346 Connecticut Ave, N.W., Washington 6, D. C.

NEW!

Alcoa Hook-Forming Tool locks ACSR cores together

- Cuts joint cost up to 42%
- Pays for itself in a few joints
- Eliminates steel sleeves

Now, sub-transmission and distribution ACSR can be joined easily, quickly and cheaply. The Alcoa® development that makes this possible is the new hook-forming tool.

This tool forms perfect hooks in the steel core—in seconds. Cores are hooked together, clinched, and the aluminum sleeve is centered over the joint and compressed. Connection is strong—more than 95% of rated conductor strength.

The new joint is considerably cheaper. For example, on #4 ACSR, the hook former cuts material costs of the joint by 42%—a few joints and the tool is paid for. Eliminated are steel sleeves and the dies for them.

Hook joints are made in ACSR sizes #6 to 2/0, inclusive, and other conductor with similar core sizes. Tool weighs only 1½ pounds and is small enough to be carried on a belt or in a pouch, yet is ruggedly built for rough service.

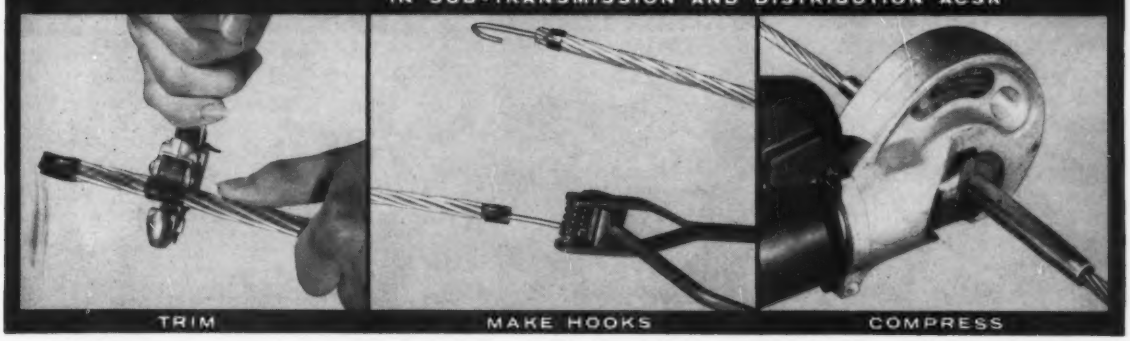
Ask your Alcoa representative to demonstrate this new cost-saving tool, or write Aluminum Company of America, 2306-K Alcoa Building, Pittsburgh 19, Pa.

ALCOA ALUMINUM CONDUCTORS & ACCESSORIES
ALUMINUM COMPANY OF AMERICA

Your Guide to the Best in Aluminum Value

THE ALCOA HOUR
TELEVISION'S FINEST LIVE DRAMA
ALTERNATE SUNDAY EVENINGS

HOW TO MAKE STRONG, FAST, ECONOMICAL JOINTS IN SUB-TRANSMISSION AND DISTRIBUTION ACSR

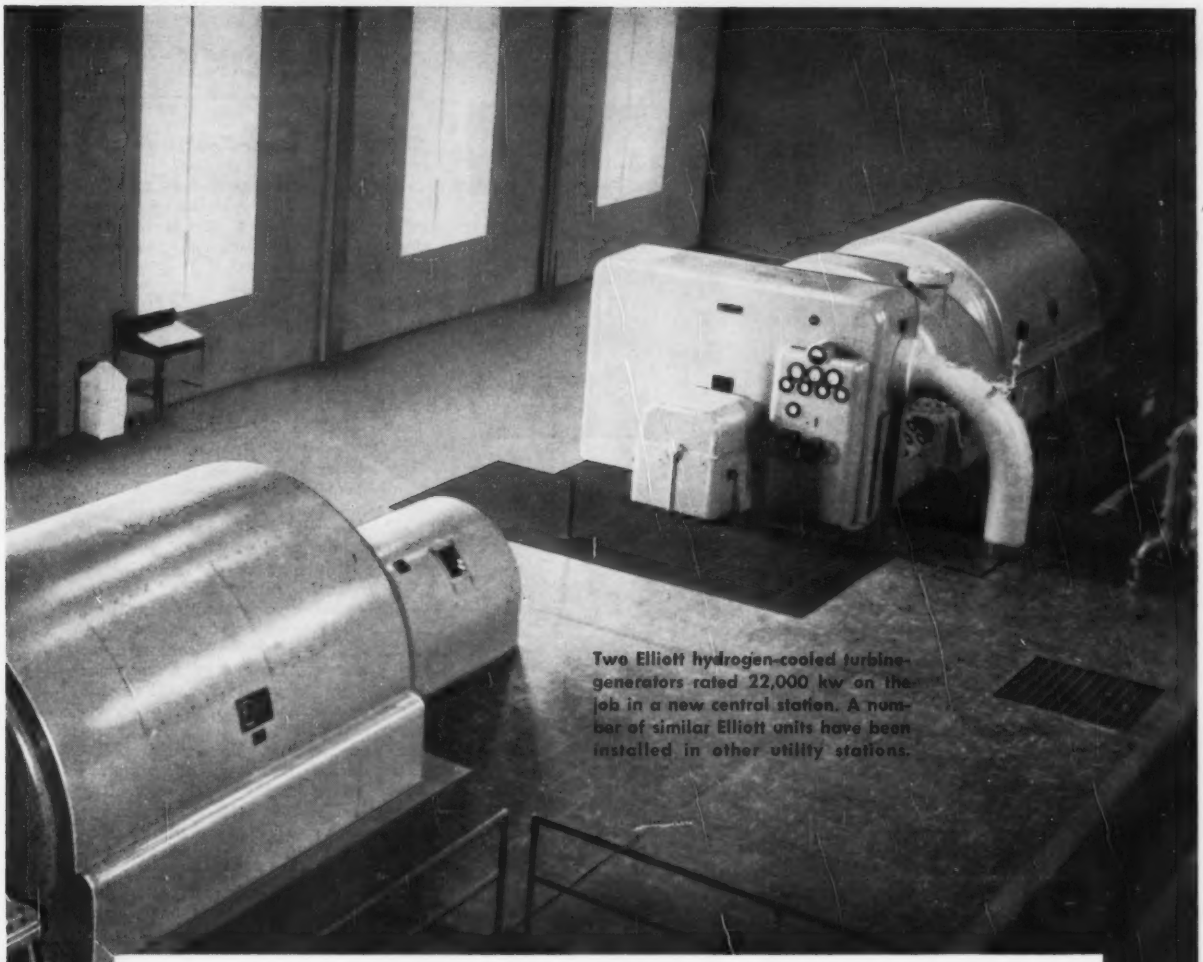


Try using a tubing cutter to score the aluminum strands, then snap them off. It's quicker. Or trim back conventionally.

Push core wire into proper size hole, close handles, and a perfect hook is made. Simplicity plus. Technique is learned in a minute. Then hook cores and clinch with pliers. Conductor is then self-supporting and core wires are in exact position for compression operation.

Center aluminum sleeve over joint and compress. Alcoa's 12-A Compressor, with 12 tons of compression in light hand tool, is recommended.

Meeting Central Station needs
with modern hydrogen-cooled
TURBINE-GENERATORS



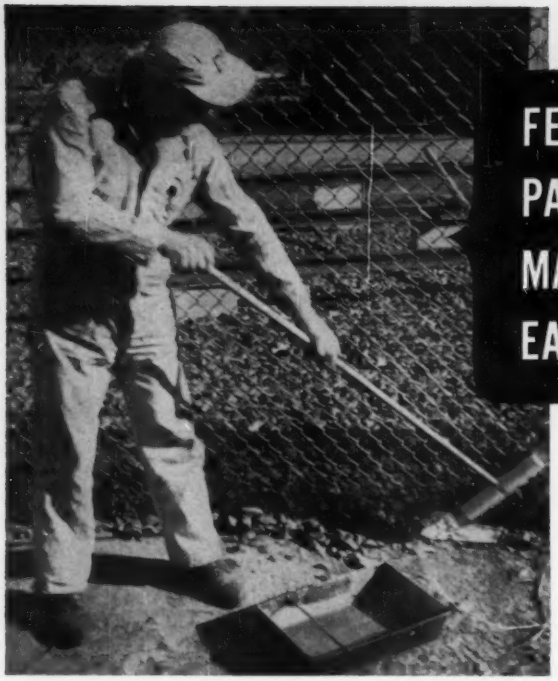
Two Elliott hydrogen-cooled turbine-generators rated 22,000 kw on the job in a new central station. A number of similar Elliott units have been installed in other utility stations.

ELLIOTT

now offers up-to-date hydrogen-cooled turbine-generators to fit utility station requirements. A number of these units in AIEE-ASME Preferred Standard Ratings, such as the two illustrated here, have already been installed and are operating efficiently and economically. To meet such requirements, Elliott shop facilities have been enlarged and new equipment has been added. All components – turbine, generator and exciters – are designed and built by Elliott in Elliott shops. They are designed and built also to produce extra dividends in performance – operating records prove capabilities beyond nameplate rating. See what Elliott can offer on your next hydrogen-cooled turbine-generator job. Call your nearest Elliott District Office or write Elliott Company, Steam Turbine Division, Jeannette, Pa.

ELLIOTT Company

H6-2



Subox makes fence painting easy and economical.

Subox paints are so simple and quick to apply that you can put them on by spray or roller coating methods — but for the fastest and most satisfactory results use an ordinary floor broom!

Subox paints are the only paints in America made with *suboxide of lead* — one of the most effective rust-inhibitive and anti-corrosive agents known. In addition, being a heavy colloidal pigment, it prevents spattering when applied to wire mesh. Subox goes on smoothly, evenly, thoroughly and adheres closely.

Next time use Subox. It costs no more than other paints and endures for many years. Comes in a wide variety of decorative colors.

Detailed instructions for easy, economical fence painting are contained in the booklet, *"Simplified Fence Painting"*. Send for a copy.

Subox Inc.

Established 1924

3 Fairmount Plant, Hackensack, N. J.

See Catalogues in Sweet's Industrial and Engineering Files.

BOOKS

Shielding Nuclear Reactors

Reactor Shielding Design Manual. Edited by Theodore Rockwell III. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. 481 pages with index, illustrated, cloth bound. Price $6.00.

Reactor Shielding Design Manual. Edited by Theodore Rockwell III. Published by D. Van Nostrand Co., Inc., 120 Alexander St., Princeton, N. J. 480 pages with index, illustrated, cloth bound. Price $6.00.

Reactor Shielding Design Manual. Edited by Theodore Rockwell III. Published by Office of Technical Services, U. S. Dept. of Commerce, Washington, D. C. Paper bound. Price $2.10.

Shielding Design is one of a series of manuals sponsored by Naval Reactors Branch of the Atomic Energy Commission. Previous manuals cover liquid metals, zirconium, beryllium, and a bibliography of reactor computer codes. Additional manuals are in preparation for corrosion and wear in water-cooled reactors, naval reactor physics design, reactor core design, reactor plant piping, reactor heat transfer, and hafnium. This entire series is an effective answer to complaints that declassification is too slow.

Manual covers the entire range of design procedures, including essential theoretical background and valuable information on shielding materials and methods of construction.

First chapter presents basic principles, including justification for the neutron-removal-cross-section concept and a brief discussion of build-up factors for the gamma absorption equations. Permissible radiation levels, biological equivalents, and specific applications of tolerances including considerations of access time, power level, and local streaming are given in Chapter 2. Specific design procedures are detailed in Chapters 3 and 4.

Plant layout factors, including distance effect, optimization of primary and secondary shielding, and shadow shielding concepts, appear in Chapter 5. And the next chapter details physical and shielding properties of usable materials, fabrication and assembly details, and operational tests for radiation levels. This is followed by special problems related to safe access after shutdown, including activation of impurities in the coolant and fission-product contamination.

Chapter 8 considers shield penetrations and other irregularities. Gamma scattering at shield boundaries is thoroughly covered. And the final chapters summarize reference mathematics for radiation flux geobetry and basic data for build-up factors, absorption coefficients, cross section, and radiation damage. Manual presents extensive information from still classified sources.

M. L. IRELAND, Jr.

Underneath this turbo generator is the fuel and the heat for an instantaneous and costly conflagration

...give your equipment the best fire protection—

A BLAW-KNOX AUTOMATIC FOG SYSTEM

Engineered to give your generators and other equipment positive protection against fires, a BLAW-KNOX *Automatic* FOG SYSTEM goes into action immediately:

- *smothers flames*
- *dissipates heat*
- *protects adjacent equipment*
- *prevents loss of revenue*
- *prevents service stoppage*
- *avoids customer complaints*

"Little Joey Sprinkler" always on the job

Why not give your equipment the BEST possible protection? Let a Blaw-Knox *fire-protection* Engineer study your needs. He will gladly submit a layout and a cost estimate . . . with no obligation to you.

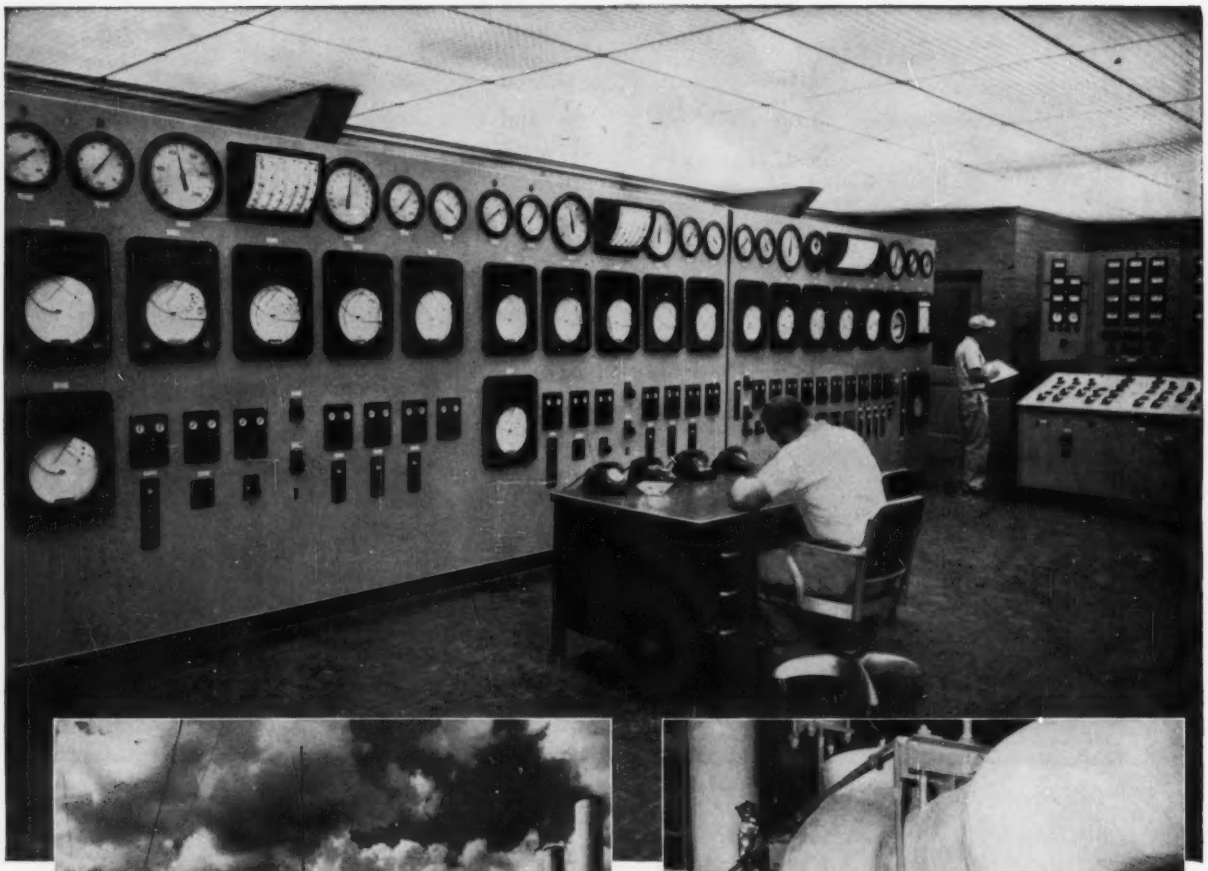
50th Anniversary BLAW-KNOX 1906-1956

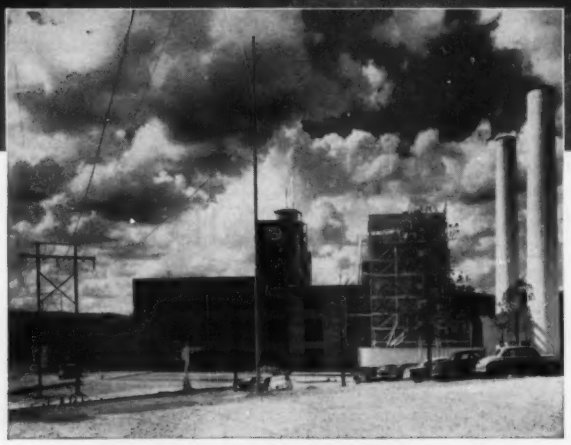
A BLAW-KNOX Automatic FIRE PROTECTION SYSTEM for EVERY NEED

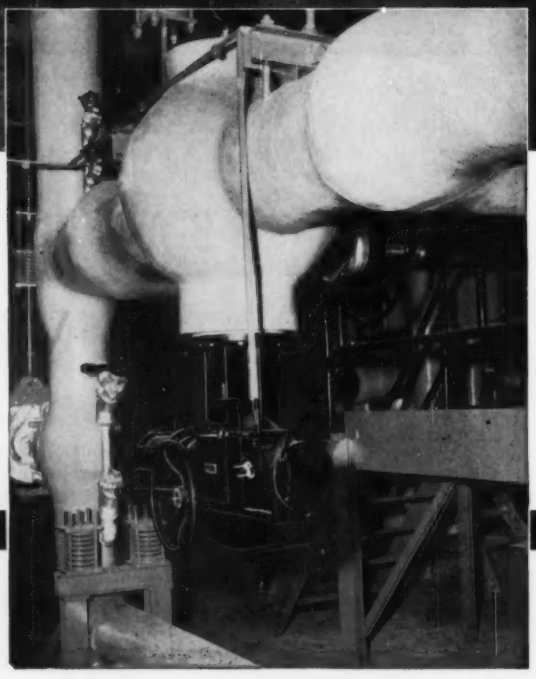
BLAW-KNOX COMPANY

Automatic Sprinkler Department • Pittsburgh 33, Pennsylvania

Here's the *1,153rd*







At Lake Catherine Station,
Arkansas Power and Light Company

***Above*—Centralized control room for Bailey Controls of Feed Water, Combustion and Steam Temperature.**

***Right*—Bailey Three-element Feed Water Control Valve.**

Installation of . . .

Bailey Three-element Feed Water Control

★ This installation of three-element feed water control at the Lake Catherine Station of Arkansas Power and Light Company is not the latest, the largest, or the most unusual; but it is important to you as a user of power generating equipment.

Here's why: It is a part of the widespread and well founded acceptance of Bailey Three-element Feed Water Control Systems. No other manufacturer can offer you an equal background of experience in this advanced method of feed water control.

Contributing to this overwhelming endorsement are several factors: Not only has the basic principle been proved and re-proved in use, but the design of the equipment has been similarly stabilized and improved. As a result, Bailey has established a reputation for successful operation in difficult installations where other systems have failed. And a twenty-five year backlog of experience has contributed unusual records for accuracy and dependability in operation.

Even more important, the Bailey field engineering service, established in important industrial centers, insures prompt and efficient service and installation supervision regardless of your location. Your local Bailey office will be glad to arrange an inspection trip to a near-by installation of Bailey Three-element Feed Water Control. Give them a call today. And for catalog literature, including a partial list of installations, write for Bulletin No. 105-C.

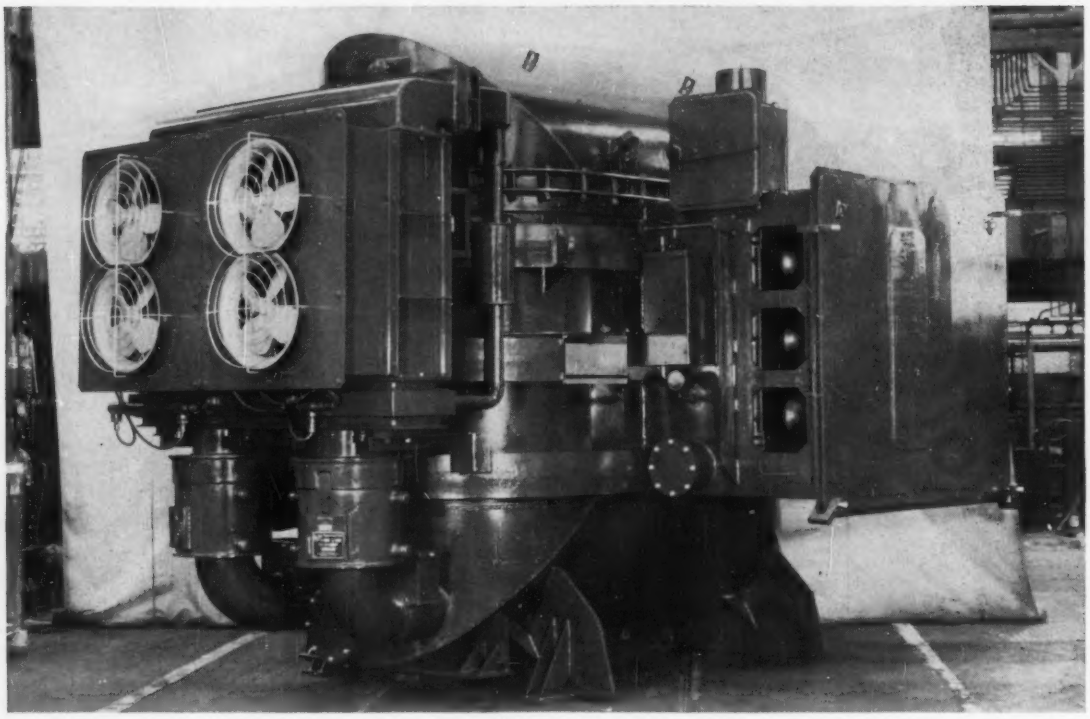
A-122-2

BAILEY
METER COMPANY
1060 IVANHOE ROAD
CLEVELAND 10, OHIO

Complete Controls for Steam Plants

BAILEY METERS

Controls for
COMBUSTION
FEED WATER
TEMPERATURE
PRESSURE
LIQUID LEVEL
FEED PUMPS



GE Ships Gas-Filled Transformer to Con Ed

A 2,000-kva transformer, which is insulated and cooled by sulphur-hexafluoride gas, was shipped late last month to Consolidated Edison Co of New York. The unit, first of two ordered from General Electric Co, is expected to lead to lighter, safer, and quieter transformers.

The gas, a compound of sulphur and fluorine with the chemical formula SF_6, possesses stable, nontoxic and nonflammable characteristics. Sealed in at 15 psi, it is forced through the transformer's magnetic steel core and copper coils. The gas absorbs heat from the core and coils and gives up heat through fan-cooled radiators.

Described as the first of its kind, the unit was developed under research and development led by Guglielmo Camilli, supervisor of advanced product engineering in GE's power transformer department. With the gas type, a 10,000-kva unit would weigh about 2,000 lb less than an equivalent oil-filled transformer, he said. Good compressibility permits nonflammable gas insulation, he added, and the low density plus compressibility cuts down transformer hum.

The unit steps down power from 69 kv to 480 v. It will be installed at Con Ed's East River station where it will power auxiliary equipment. After field testing, it will go into service as part of the distribution network.

Two Features For NEMA Annual Meeting

"NEMA on Parade," a stage production, will be a feature of the National Electrical Manufacturers Association 30th annual meeting on November 14 at Atlantic City, N. J. An all-professional cast will present the play.

Aim of the presentation is to show those viewing it how the various industry programs affect them individually, and how the success of these programs affect their jobs and their opportunities.

Fischer Black, publisher and editor of Electrical World, will be the featured speaker at the annual meeting and dinner of the Electrical Measuring Equipment Section to be held during the NEMA meeting on Tuesday, November 13, 1956, at 8:00 pm.

With "Electrical Markets" as the topic, Black's talk will cover the economic outlook for the industry and will be specifically related to the area of interest to members of EMES.

NBS to Have New Labs

Relocation of Washington laboratories of the National Bureau of Standards will be to a 550-acre site near Gaithersburg, Md. New buildings will replace present research facilities. Transfer of operations to the new location is expected to be completed in about 5 years. Research must now be conducted for new and improved standards and measurement methods.

(*More M&M on page* 259)

TO THE MEN RESPONSIBLE FOR

Telephone Communications in American Business

We'd like to show you how a great many leading companies have improved their communications and pocketed sizable savings with P-A-X—the "inside" business telephone system.

P-A-X keeps your present switchboard and phones free for outside calls. Lets you make inside calls in a flash—OVER YOUR OWN PRIVATE TELEPHONE SYSTEM. And P-A-X sharply cuts telephone operating costs.

Top firms in all industries save time and money with P-A-X—in fact, they tell us they'd be in a jam without it. See for yourself. Let us send you interesting case history studies that give facts and figures.

Write: Automatic Electric Sales Corporation, 1033 W. Van Buren Street, Chicago 7, Ill. *In Canada:* Automatic Electric Sales (Canada) Ltd., 185 Bartley Drive, Toronto. *Offices in principal cities.*

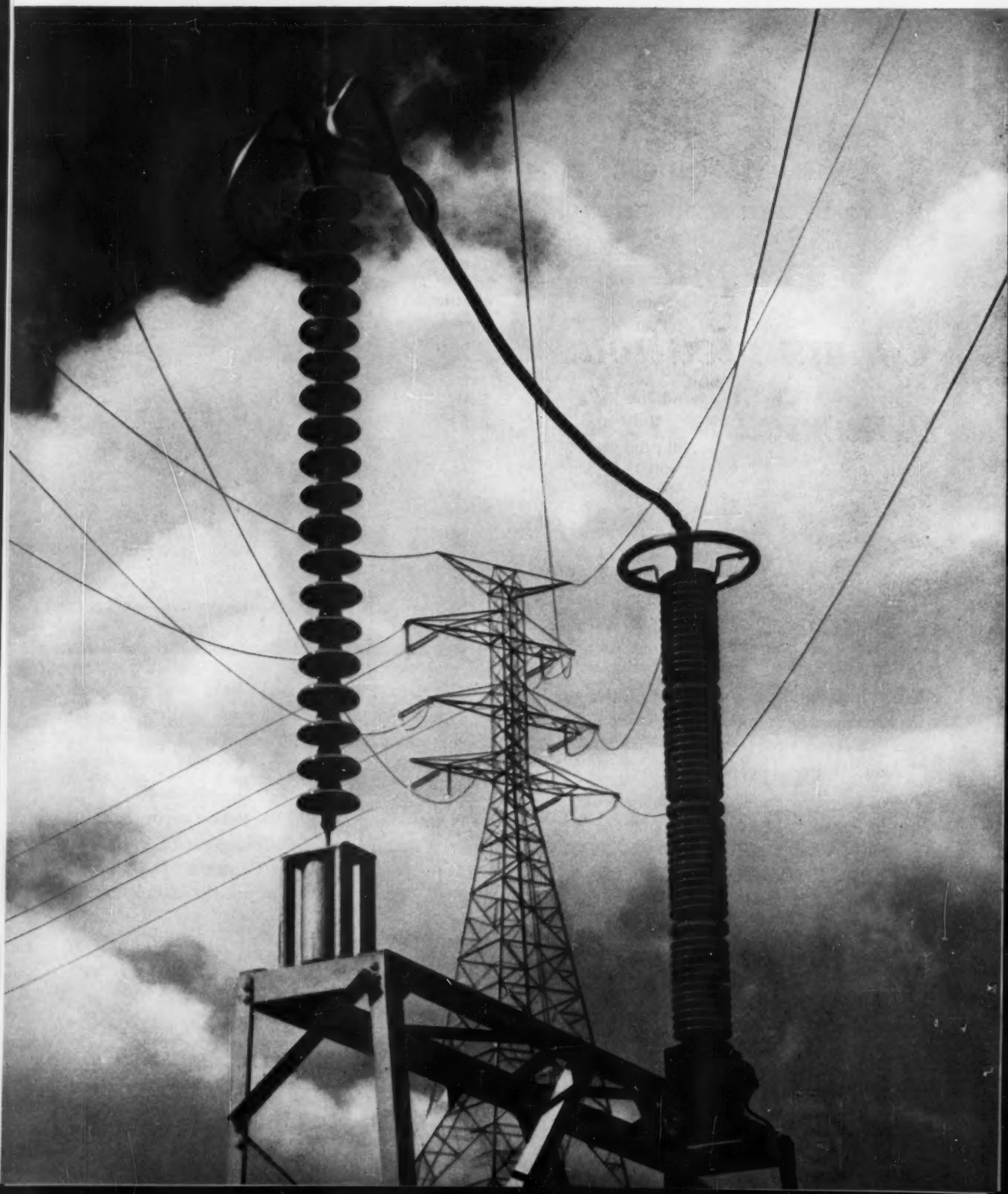
P-A-X *business telephone systems*

AUTOMATIC ELECTRIC

Originators of the dial telephone · Pioneers in automatic control

GENERAL TELEPHONE SYSTEM

For the Mass



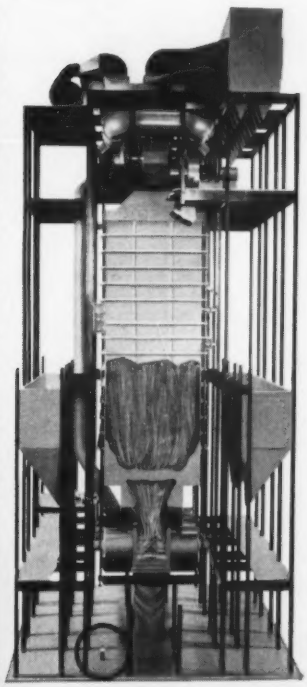
Production of Energy

"AMERICAN GAS AND ELECTRIC SYSTEM looks for a higher level of efficiency in the production of electric power than has ever been achieved before."

This firm prediction by Philip Sporn, president of the American Gas and Electric System, refers to the two largest steam-electric generating units in the world, which are to be added to the facilities of AGE.

Second and Third Universal Pressure Units for AGE

Each unit will produce 450,000 kw, enough power to supply the residential need for a city of 4,000,000 people—*more electricity than many complete utility systems.* Steam generators for the two units are of the B&W Universal Pressure type, and will be the second and third to go into commercial service .The first will start producing power at Ohio Power's Philo Plant in the near future.



Cyclone Furnace-fired B&W Universal Pressure Steam Generator to serve 450 MW turbine. Design pressure 4500 psi. Generates 2,900,000 pounds of steam per hour at 3625 psi, 1050 F. There are two stages of reheat to 1050 F. The second unit is similar in design but will be pulverized-coal-fired. Note comparison with six foot man standing at basement level.

Coal the Main Energy Source for Years Ahead

The decision to go ahead with these super-pressure, coal-fired units is based upon the fact that the bulk of our energy, for many years ahead, will come from coal, burned efficiently with economical equipment.

Two Firing Methods Utilized

Each of the B&W Universal Pressure Units will generate 2,900,000 lb of steam per hour. One will be Cyclone Furnace-fired and the other pulverized-coal-fired, to take greatest advantage of the method better suited to fuel and operating conditions in each case.

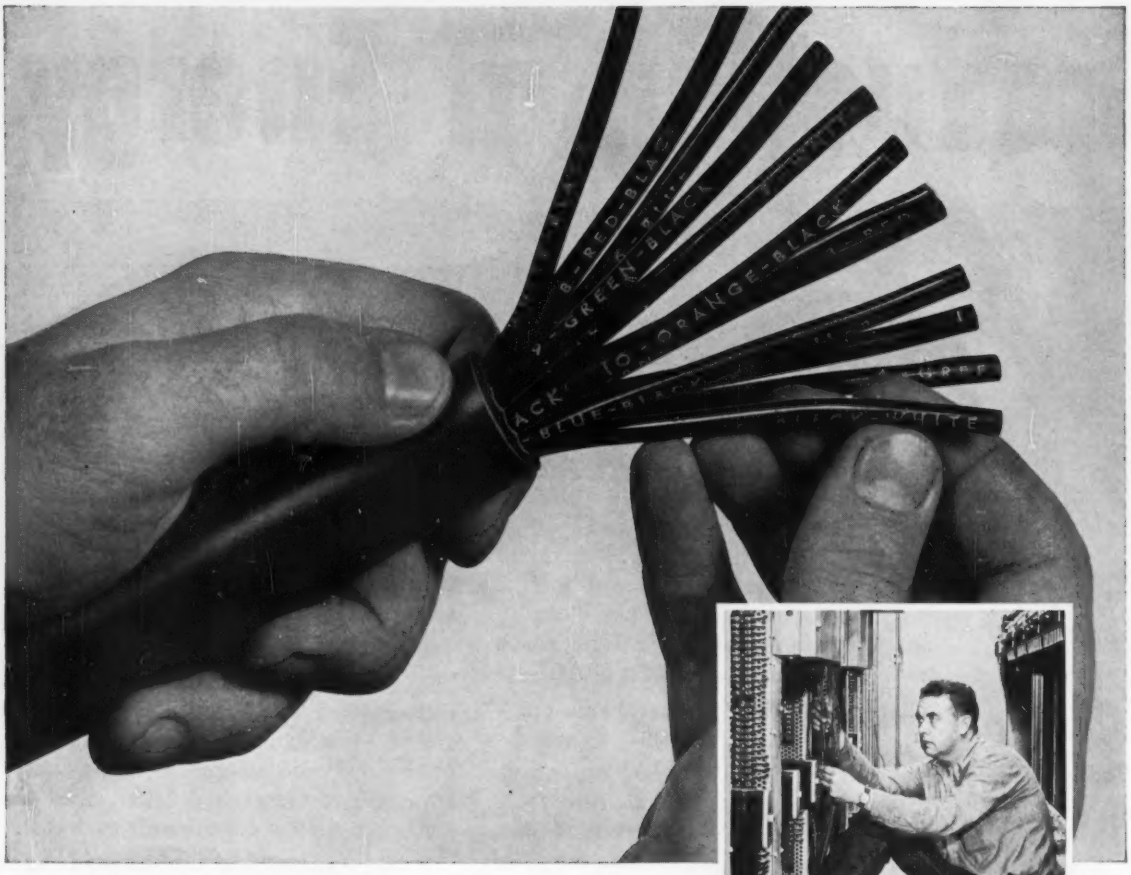
It takes courage and confidence in their engineering ability for AGE to initiate these world's largest generating units—and this confidence is reinforced by the work of the B&W organization and by previous experience with B&W research, engineering, manufacturing, field development and erection. These capabilities, skills and facilities are the real resources of B&W. For nearly 100 years they have been dedicated to serving the current and future steam-electric power needs of the nation.

The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

BABCOCK & WILCOX

BOILER DIVISION

G-812



Color-coded and numbered every 1 ½"

New Rome station control cable assures quick and positive circuit identification

You can reduce installation expenses and the cost of routine maintenance by specifying Rome control cable (CRO-1) for your next job. Rome's new surface-printed color coding makes it much easier to quickly identify control circuits, even when light is poor or when handling has dirtied conductor coverings. Every conductor is color-coded and numbered *on both sides* at intervals of 1½" or less, and permanently clear white lettering provides maximum legibility.

Three different types of Rome control cable are available:

RoZone insulated—RoPrene sheathed • This is the ultimate in control cable design and performance. Conductors are insulated with RoZone, a high-quality oil-base compound and each conductor is individually sheathed with RoPrene (Neoprene). A RoPrene jacket provides over-all protection. Ask for Type CRO-1.

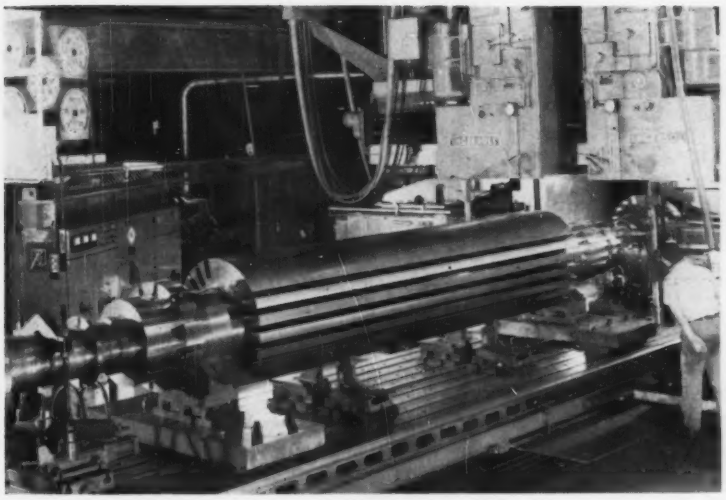
RoMarine insulated—RoPrene sheathed • This is a more moderately priced, high-quality, general purpose design. Individual conductors are insulated with a heat- and moisture-resistant synthetic rubber compound, and the over-all jacket is RoPrene (Neoprene). Specify Type CRM-1.

Rome Synthinol insulated—Rome Synthinol or RoLene sheathed • This cable features a quality thermoplastic construction with Synthinol insulation (polyvinyl chloride) protected by a Synthinol or RoLene jacket. A small diameter moderate cost control cable, this is our Type CT-2.

SPECIFY ROME STATION CONTROL CABLES FOR YOUR NEXT JOB. And if you would like more information on this product, contact your nearby Rome Cable Sales Office. Or write to Department 800.

It costs less to buy the best

ROME CABLE Corporation
ROME • NEW YORK
and
TORRANCE • CALIFORNIA



A-C Uses Big Machine for Big Job

The rotor shown is for one of two generators in a 300 Mw close-coupled, cross-compound reheat steam turbine generator unit for Detroit Edison Co. It is being machined at Allis-Chalmers West Allis Works on a large specially designed adjustable rail milling machine. The machine has four 75-hp heads and a maximum over-all width, height and length of 28, 18½ and 102 ft, respectively. With a table carrying capacity of 175 tons, it can be used as a conventional 4-head planer as well as a rotor slotter.

The generator for the rotor will reportedly be rated at 175,000 kw, 18,000 v and 3,600 rpm, and it will have fully supercharged conductor-cooling using hydrogen. Casings for the units are said to weigh approximately 150 tons.

National Power Show To Disclose New Fields

The 22nd National Exposition of Power and Mechanical Engineering will be held November 26-30 at the New York Coliseum. The return of the exposition to New York after four years is marked by the introduction of several new sections of displays.

Newest feature will be the Rockets & Missiles Section with 20 exhibits.

The Atomic Section, appearing for the first time in New York, will have exhibits of a 75,000-kw electric power reactor plant for Southern California Edison Co; a 12,500-kw reactor-generator at Piqua, Ohio; a small experimental unit in Idaho; a 50-kw solution-type research reactor for Japan, and a panel describing a 10,000-kw sodium-deutrium reactor proposed for Anchorage, Alaska.

A closed-cycle gas turbine concept is viewed with favor for use in stationary and mobile power plants.

For chemical treatment of boiler water, there will be shown a controlled-volume pump with high-pressure head assembly, rated at 9.4 gph at a discharge pressure of 3,200 psig.

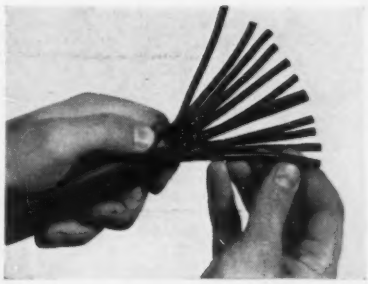
Model generating stations will reveal the latest conceptions in designs for a complete plant.

Other exhibits will include transformers of the distribution dry type, network and subway type, power type, and equipment testing type; also mercury-switch equipped controls for indoor, outdoor and hazardous locations; and closed-circuit television for viewing a well to a depth of about 600 ft.

MMM Reduced Tape Price

Minnesota Mining & Mfg Co, St. Paul, Minn., announced a price reduction ranging from 3 to 7% for its "Scotch" brand PTF electrical insulation films and tape.

(*More M&M on page* 262)



New Rome Station Control Cables

Can be ordered from any one of the following sales offices:

ROME CABLE SALES OFFICES

*ATLANTA 13, GA.
156 Simpson St., N.W.
MUrray 8-9860

BOSTON 10, MASS.
Chamber of Commerce Bldg.
80 Federal St.
HAncock 6-7272

*CHICAGO 39, ILL.
4505 West Grand Ave.
SPaulding 2-2700

CLEVELAND 14, OHIO
Society for Savings Bldg.
145 Public Square
SUperior 1-1240

*DALLAS 26, TEXAS
3015 Taylor St.
PRospect 4801

*DENVER 4, COLO.
1160 Elati St.
KEystone 4-0533

DETROIT 2, MICH.
547 New Center Bldg.
TRinity 2-7578

*HOUSTON 2, TEXAS
240 Shea Place
FAirfax 3-8385

KANSAS CITY 11, MO.
406 West 34th St.
JEfferson 1-4146

*LOS ANGELES 22, CALIF.
2510 South Malt Ave.
RAymond 3-3631

NEW YORK 17, N. Y.
60 East 42nd St.
MUrray Hill 2-6590

PHILADELPHIA 7, PA.
12 South Twelfth St.
MArket 7-2070

PITTSBURGH 22, PA.
1001 Oliver Bldg.
ATlantic 1-0816

ST. LOUIS 17, MO.
6617 Clayton Rd.
VOlunteer 3-4944

*ST. PAUL 4, MINN.
345 N. Wheeler Ave.
MIdway 6-7201

*SALT LAKE CITY 1, UTAH
230 South Fourth West St.
ELgin 9-8811

*SAN FRANCISCO 24, CALIF.
1100 Selby St.
VAlencia 6-3580

*SEATTLE 4, WASH.
3430 Fourth Ave., South
SEneca 3017

TULSA 14, OKLAHOMA
2438 East 21st St.
RIverside 2-1704

*Stock distribution center

General offices: Rome, N. Y.

Factories.
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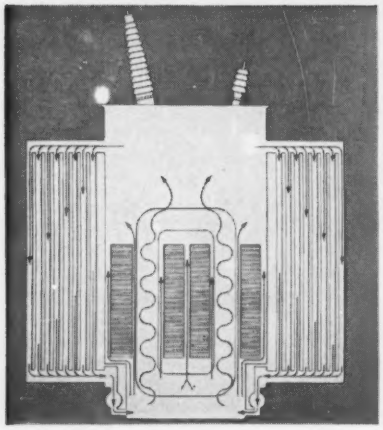
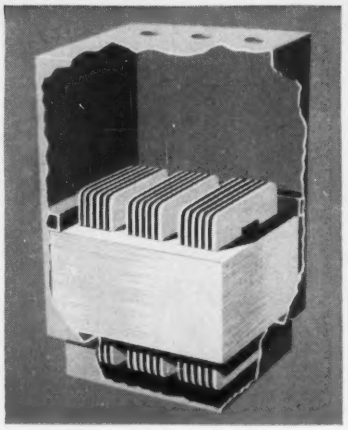
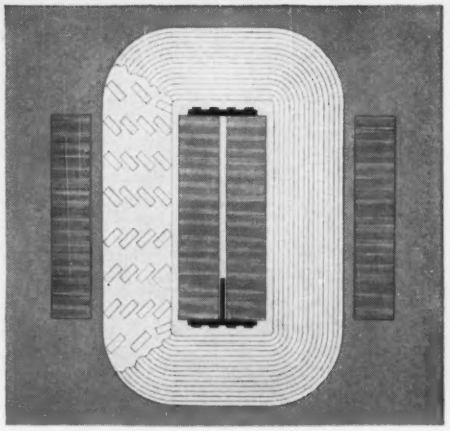
World's largest—400,000-kva, 330-kv, Westinghouse Form-Fit auto transformer in operation at Indiana & Michigan Electric Company's Tanners Creek plant, Lawrenceburg, Indiana.



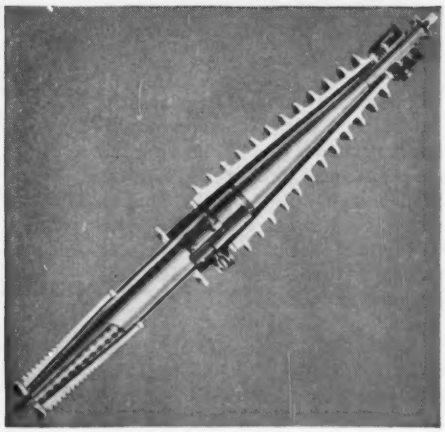
High Thermal Capacity—Forced-oil cooling improves performance of heat transfer system . . . prolongs transformer life by reducing hot spot temperatures, boosts capacity by as much as 67% and results in smaller, lighter weight transformers.



Space, Weight Saver—Close-fitting, rugged tank withstands rough handling; provides compact, low-weight unit which can be shipped upright. Design also reduces weight and maintenance of coolant oil normally required in greater quantities in other types of construction.



Improved Performance—Shell-form design puts core iron on the outside, coils on the inside. Natural vertical cooling arrangement improves thermal characteristics; creepage surfaces are eliminated; voltage oscillations are reduced for improved dielectric characteristics.



Proved Dependability—More than 200,000 Westinghouse condenser bushings have been in operation for a total of a million bushing years with a 99.98% perfect service record. Result: greater protection and more dependable service continuity for your system.

At Record Breaking Capacities . . .

Here's How Westinghouse Brings You Long-Term Economy in Power Transformers

Westinghouse engineering brings you long-term economy in power transformers by constantly increasing capacity while making practical reductions in size and weight. These improvements have been effected through development of better materials and a more efficient design arrangement.

Strong evidence of success in this effort is the Westinghouse line of "Form-Fit" power transformers which are smaller and lighter per kva than any other design.

These transformers use steel cores made of Hipersil®, a cold-rolled silicon steel which has superior magnetic properties—very high permeability and very low losses. In the Westinghouse shell-form design, the core surrounds, supports and protects the coils, giving them added mechanical strength.

To provide utmost reliability, Westinghouse now impulse tests all power transformers, rated over 10,000 kva and 69 kv, right on the production line. This exclusive quality-control measure assures you that transformers delivered will be free of defects and capable of giving continuous service.

Westinghouse leadership in design engineering is your assurance of superior power transformer performance. Get in touch with your Westinghouse sales engineer, or write Westinghouse Electric Corp., 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pa. J-70755

YOU CAN BE SURE...IF IT'S

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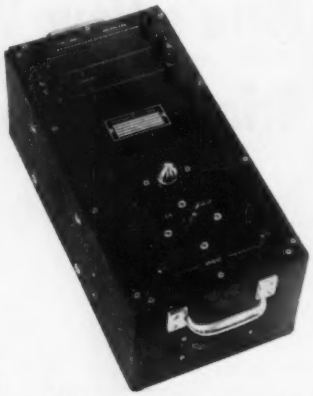
BIDDLE *Instrument News*

SEELY MOTOR TESTER

for measuring the electric resistance of a-c energized windings

The Seely Motor Tester circuits provide a simple means of measuring the electric resistance of a-c energized windings while at the same time observing winding temperatures under actual load conditions.

Since its conception, 7 years ago, this equipment has proved very useful for determining the winding temperature of induction motors. It has been particularly effective for testing hermetic refrigeration motors, since thermocouples cannot be readily used and since these motors cannot be shut down during test for resistance readings, without disrupting the test.



The latest circuit enclosure for measuring resistance of a-c energized windings. The circuit is rated at 20 amperes, 250 volts, 60 cycles, single-phase or polyphase, 0.2 to 100 ohms.

For full **INFORMATION** and **PRICES** request **BULLETIN 70W**

FRAHM® FREQUENCY MONITOR

. . . for opening or closing an electrical contact when the frequency of the power line to which the monitor is connected reaches a preset limit. The monitor can be furnished for low or for high limit operation.

TYPICAL APPLICATIONS

. . . In power transmission systems as a low frequency alarm with manual reset to call for load shedding or other corrective action to bring system frequency back to normal.

. . . For generators as low and high frequency alarm and, under certain conditions, as simple "on-off" frequency controller which can keep frequency between preset low and high limit.

. . . For turbines and other machinery with parts rotating at high speed as overspeed alarm and limiter when used in conjunction with an electric tachometer generator.

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British May Invite Bids From US Firms

London — (McGraw-Hill WORLD NEWS) — Introducing the Central Electric Authority's Eighth Annual Report published September 26, the Authority's chairman, Lord Citrine, announced that CEA is likely in the near future to invite tenders from US firms for very large transformers in competition with British firms.

Other important points in Lord Citrine's speech were that within a few days the Authority will receive tenders for the construction of the first two nuclear power stations of the national program under which 12 stations are to be built.

Other facts stated in the report are: (1) The number of consumers in Britain rose by 443,000 (3.2%) to more than 14,146,000; and (2) CEA now owns 274 power stations.

M&M BRIEFS

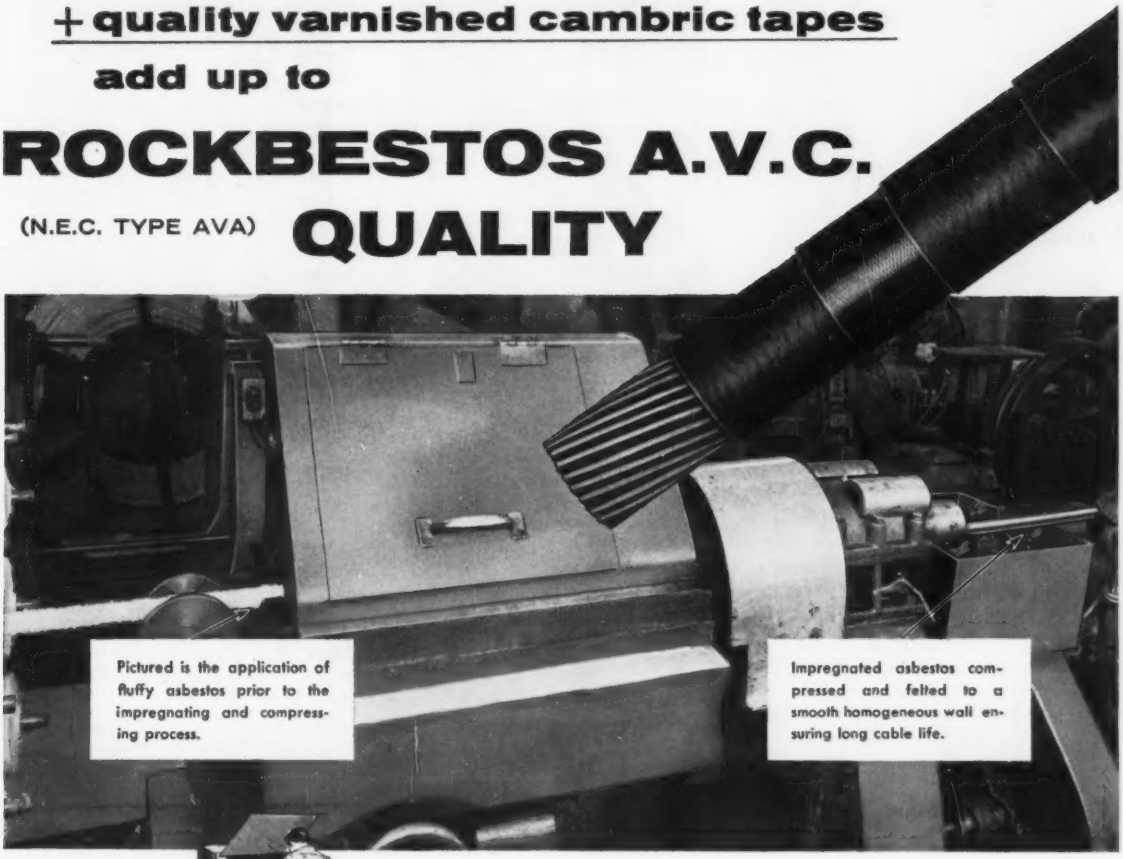
Marco Industries, Inc, Womelsdorf, Pa., celebrated its 10th anniversary recently by turning out it's 6,000,000th motor. The firm manufactures fractional hp motors for the air moving equipment industry.

Automatic Transportation Co, 149 W. 87 Street, Chicago 20, Ill., through one of its spokesmen, predicted that sales of materials handling equipment to the iron and steel market will increase by at least 100% during the next 10 years.

Minneapolis-Honeywell Regulator Co, Minneapolis, Minn., is reportedly making preparations to enter the electronic air cleaning field. Working in cooperation with Trion, Inc, of McKees Rocks, Pa., the company will develop and produce electronic air cleaning equipment, and will begin marketing activities early in 1957.

Sorenson & Co, Stamford, Conn., manufacturers of power supplies and voltage regulators for electronic and allied industries, has merged with Beta Electric Corp of New York. Beta has become an operating division of Sorenson & Co. Dr. Victor Weuk will remain as engineering director and general manager of the newly created division.

SELECTED COMPOUNDS
in felted asbestos walls
+ quality varnished cambric tapes
add up to
ROCKBESTOS A.V.C.
(N.E.C. TYPE AVA) QUALITY



Pictured is the application of fluffy asbestos prior to the impregnating and compressing process.

Impregnated asbestos compressed and felted to a smooth homogeneous wall ensuring long cable life.

Compounds — specially selected compounds — which are used to impregnate asbestos walls, are one of the important reasons why you can count on Rockbestos A.V.C. for dependable, long lasting service.

For this impregnation, Rockbestos engineers not only set up rigid compound specifications but conduct a continuing testing program to insure that these standards are always met. Thus, the exactly right compound is applied to the asbestos wall at the correct temperature and at the correct pressure. *The Result . . . the seamless, felted Rockbestos wall.*

In Rockbestos A.V.C. impregnated felted asbestos walls seal varnished cambric tapes away from air and moisture. The tapes are made to Rockbestos specifications and are applied under controlled methods assuring uniform dielectric strength.

Rockbestos A.V.C. gives you long life and dependable service under every type of operating condition . . . in temperatures up to 230°F.

Complete construction and test specifications of Rockbestos A.V.C. are in the new booklet "Specification RSS-88". Write today for your copy.

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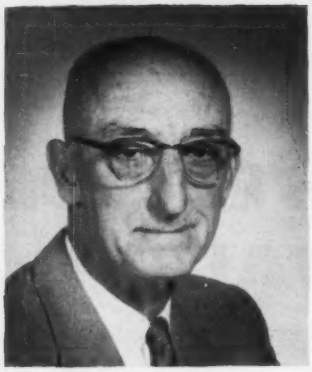
STOCKED COAST TO COAST
Standard Rockbestos A.V.C. construction (N.E.C. types AVA, AVB, etc.) are available for immediate shipment. Call or write nearest branch office.

EDWARD L. SHUTTS



HAROLD L. MANN

ROBERT W. GREENLEAF

Iowa Southern Makes Top Executive Changes

In recent executive changes at Iowa Southern Utilities Co, Edward L. Shutts, president, was elected to the newly created post of board chairman and Harold L. Mann was named new president. Robert W. Greenleaf, formerly vice president, succeeds Mann as executive vice president.

Shutts, who remains chief executive officer with responsibility for over-all affairs of the company, has been with Iowa Southern for the past 40 years. He served as auditor and assistant secretary prior to his 1937 appointment as president, treasurer, and a director.

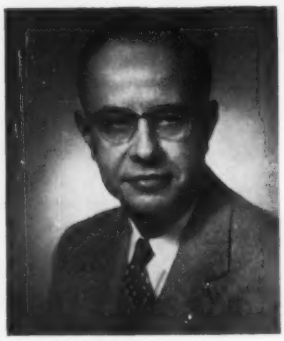
Mann, executive vice president since 1949, started his utility career in 1916 with Burlington Railway & Light Co. In 1925, when the firm's properties were acquired by Iowa Southern, he was made manager of the Chariton district. He was appointed assistant to the president in 1946 and has served in that position since.

Greenleaf joined Iowa Southern in 1952 as a vice president. In 1954 he was elected to the board of directors and later became vice president and treasurer. Prior to joining the utility, he served the company in legal matters as a member of the firm of Valentine and Greenleaf.

Tuepker Advanced to President

New president of Public Service Co of Oklahoma is D. J. Tuepker, director of public affairs since 1948. R. K. Lane, president since 1939, now becomes board chairman. Both appointments are effective Nov 1.

Tuepker has served in various capacities since he joined the utility in 1923. After holding posts as assistant auditor and assistant purchasing agent, he became purchasing agent in 1936. In 1939 he directed the education of employee service to customers for public affairs department, and in 1942 advanced to Vinita area manager. He was elected a director in 1949.



D. J. TUEPKER

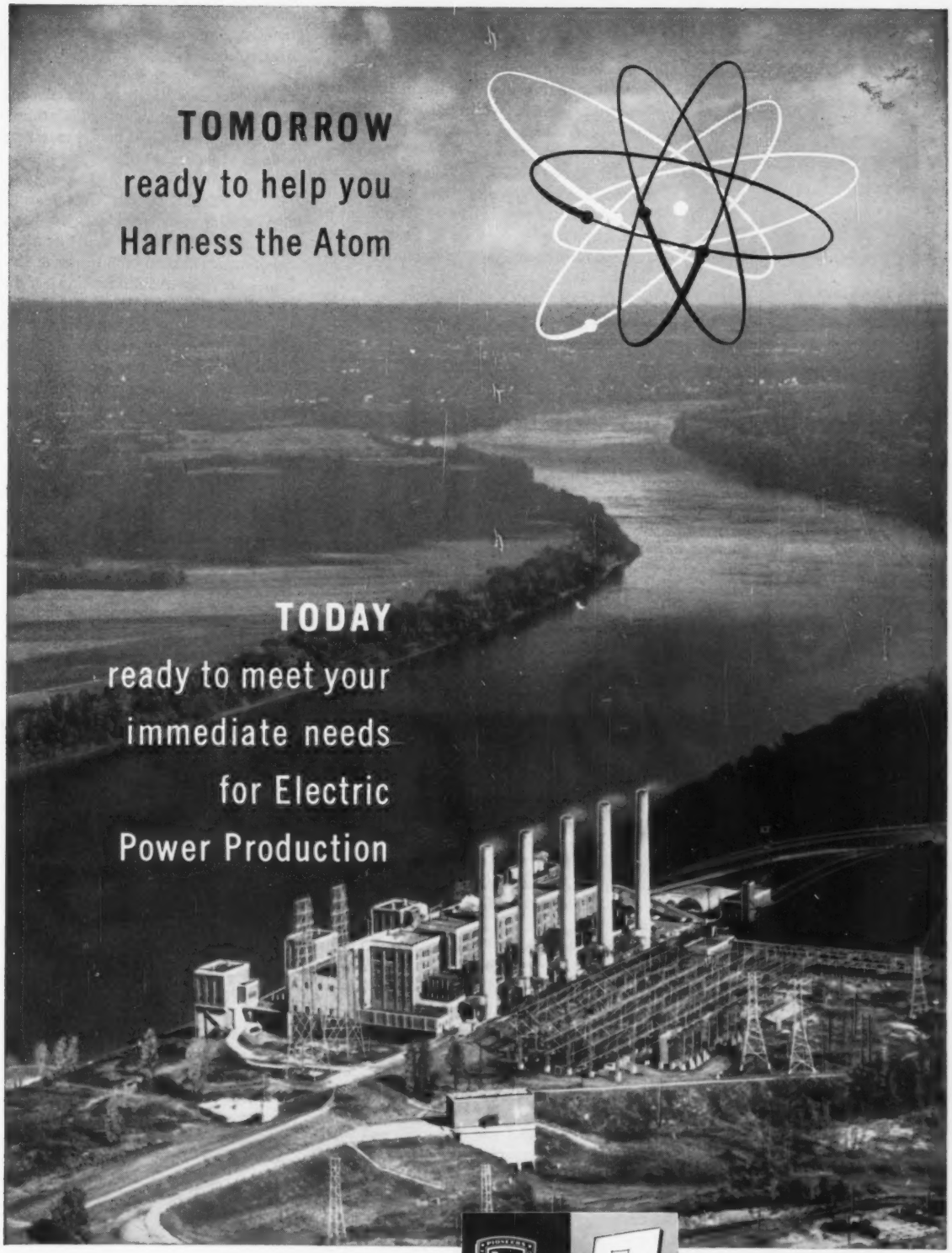
KENNETH B. SPRAGUE

A&FP Names Sprague VP

American & Foreign Power Co, Inc, has elected Kenneth B. Sprague vice president in charge of treasury and accounting matters.

Sprague, a graduate of Syracuse University and Brooklyn Law School, has spent his entire business career with companies affiliated with the A&FP system.

Also newly appointed were George R. Herbert, treasurer; W. T. Bligh, comptroller of Ebasco International Corp, a subsidiary; J. D. Weatherup, A&FP comptroller; and John J. Carroll, assistant comptroller.



Pioneer Service & Engineering Co.

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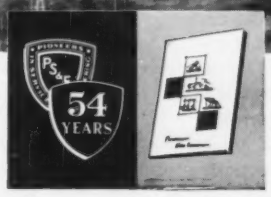

Serving power plant needs of Industries and Utilities for 54 years.

Send for our descriptive booklet, "Pioneering New Horizons"

Rochester G&E Promotes Fiedler

GEORGE H. FIEDLER

Rochester Gas & Electric Corp's new general superintendent of the Electric and Steam Division is George H. Fiedler, previously superintendent of electric distribution.

A 1921 graduate of Cornell University, Fiedler joined RG&E as a cadet engineer in the Electric Division, and advanced to his most recent post in 1949. At present he is also chairman of Edison Electric Institute's Transmission and Distribution Committee.

Anaconda Aluminum Ups Lewis to VP

MORD LEWIS

Mord Lewis, former assistant to the vice president of operations of Anaconda Co, has been elected vice president of Anaconda Aluminum Co, 95%-owned subsidiary.

He joined the parent firm in 1926, and aside from two years as a Harvard University instructor and five years with Reconstruction Finance Corp and Securities & Exchange Commission has served Anaconda ever since in various geological and mining engineering capacities.

PERSONAL BRIEFS

New system distribution engineer of Appalachian Electric Power Co is **Harold F. Rozier,** who succeeds the late **John F. Nash** . . . Portland General Electric Co has appointed **Arthur H. Greisser** superintendent of production.

Columbus & Southern Ohio Electric Co's **William H. Nelson** advances to superintendent of the Conesville Generating station now under construction. **H. David Leppla** is new assistant superintendent.

Retirement of Utah Power & Light Co's **A. C. Kelm** as assistant chief engineer has resulted in the following advancements in the department: **Ralph A. Radford,** former electrical engineer, becomes assistant chief engineer; **Edgar W. Hempel,** as general distribution engineer, assumes duties formerly handled by Kelm, reporting to Chief Engineer **Harold Boehmer; C. L. Ericson,** assistant to the chief engineer; **Robert W. Moody,** system electrical engineer; **William E. Clements, Jr,** assistant distribution engineer; and **Herman O. Rohner,** transmission engineer.

Anton T. Haendler is Boston Edison Co's newly appointed superintendent of the production and system operating departments. He was previously assistant superintendent of system operation and chief of electrical operations in the production department.

Rochester Gas & Electric Corp has promoted **R. Dewitt Pike** to director of the employee relations department.

R. W. Shriver is new superintendent of Anderson (Ind.) municipal light plant. **Frank Yarling,** acting superintendent, remains as superintendent of distribution.

L. A. McCants has been named construction superintendent of Carolina Power & Light Co's new generating unit at Moncure, N. C.

Federal Pacific Electric Co's **Harold J. Vorzimer,** vice president, has been appointed director of the Electrical Equipment Division of Business & Defense Services Administration, U. S. Department of Commerce.

John A. Thornton has been elected secretary and treasurer, and **Lewis H. Bethel** as assistant secretary and assistant treasurer of Kennecott Wire & Cable Co, subsidiary of Kennecott Copper Corp.

J. F. Costigan, works manager of Allis-Chalmers Manufacturing Co's Norwood Works, has been named assistant director of manufacturing, industries group.

Newly appointed manager of Square D Co's manufacturing plant to be built at Lexington, Ky, is **Walter Nollenberger. Stephen Kovach** becomes manager of the regional assembly plant now under construction in Atlanta, Ga.

Thomas M. Wallace, formerly manager of manufacturing for miniature lamp department at Nela Park, has been named manager of manufacturing for General Electric Co's large lamp department. Wallace succeeds **Henry F. DeLong,** new general manager of cathode ray tube department of GE's Electronics Components Division. **Donald J. Mayer** succeeds Wallace to become manager of large lamp and warehousing and field services . . . **Costas Sfikas** has been appointed turbine specialist for GE's International Division . . . GE's industrial computer section has designated **Arthur G. Newman** as manager of employee and plant community relations . . . In Tyler, Texas, GE's home heating and cooling department has appointed **Robert K. Miller** general manager.

Raymond W. Saxon, who formerly served as manager of Radio Corp of America's Northeastern region, Boston, has been appointed director of regional operations.

New INTERNATIONAL
6-wheel-drive trucks!

Now, NEW INTERNATIONAL Tandems with 6 *working* wheels! Powerful, load-lugging brutes with plenty of extra traction and pull for the most rugged off-highway operations! Plus roomy comfort and easy handling for highway hauling!

Here are new "work horses" that are truly thoroughbreds. They are completely designed and all-truck built by INTERNATIONAL at the factory. There are no compromises or conversions. You get the long-lasting dependability and penny-pinching economy that *earns* you, *saves* you the BIG money.

Get complete details of these all-wheel-drive trucks from your INTERNATIONAL Dealer or Branch today. Models from 22,000 to 33,000 lbs. GVW.

INTERNATIONAL HARVESTER COMPANY • CHICAGO

Only 6 x 6 trucks with all these features:

- **New heavy-duty steering gear and relay assembly for proper ratios . . . easier, safer steering.**
- **Low body and cab height. Ample ground clearance.**
- **Full load-length frame reinforcements that extend beyond front spring front-mounting brackets for additional strength and rigidity.**
- **New "cloverleaf" type transfer case with straight-thru drive for quieter operation and longer driveline life.**
- **New 10-inch sealed parking brake provides extra safety and reduced maintenance.**
- **Famous Comfo-Vision cab with double wall back panel construction and shock absorbing cab mountings to endure the punishment of all off-highway operations. Seats three husky men comfortably.**
- **Cast spoke wheels and tubeless tires standard.**
- **Front-mounted winch, full-torque power take-off and all needed equipment available from the factory.**

INTERNATIONAL TRUCKS

All-Truck Built to save you the BIG money!

Motor Trucks • Crawler Tractors • Construction Equipment
McCormick® Farm Equipment and Farmall® Tractors

Even rocks won't stop this Tel·E·Lect digger!

- **Time Tested, Proven, Accepted**
- **Used by Public Utilities Everywhere**
- **Operates on Any Derrick Truck**
- **Nationwide Sales-Service Facilities**

Rugged construction from hardened steel auger to power take-off lets this time-tested Tel-E-Lect Pole Hole Digger work in all soil conditions . . . smart design lets Tel-E-Lect's digger reach up on hills, down into ditches, or across obstacles—anywhere up to 20 feet behind the truck!

Put this low cost, industry accepted unit on the front or rear of your utility truck . . . see your two-man crew dig a hole and set a pole in less than five minutes. The Tel-E-Lect digger will bore clean holes 10 feet deep. Interchangeable augers 8" to 20" in diameter are offered.

The digger is lifted by truck's boom and winch. Engine power is delivered to the digger through a telescoping drive shaft and the auger can be rotated in either direction by shifting the PTO.

All Tel-E-Lect products are sold and serviced through a nationwide distributorship plan. You'll find your local dealer listed under "Trucks-Equipment" in the yellow pages, or *write direct for complete information.*

This 2-man utility truck is completely equipped by Tel-E-Lect. Its derrick and digger are stowed overhead for travel.

Once on the job, the derrick and digger are raised automatically with the winch . . . no need for a big crew with this compact unit.

In two minutes the Tel-E-Lect derrick and digger are in position, ready to work. Note that the pole is used as additional weight to force the auger into the frozen ground.

Tel·E·Lect PRODUCTS, INC.

10,003 Minnetonka Boulevard Minneapolis 26, Minnesota

SALES ASSIGNMENTS

COMPANY STAFFS

Allis-Chalmers Manufacturing Co's Industries Group has named Richard L. McDermott and Donald K. Proctor as new representatives in the Cincinnati and Boston districts, respectively . . . New Industries Group service supervisor for the Mid-Atlantic region is Otto M. Wiggins, who replaces William R. Call, now assigned to the Philadelphia sales organization.

Babcock & Wilcox Co has appointed Ralph R. Ryan as sales representative of the Detroit district of the Tubular Products Division.

General Electric Co's radio communication equipment component has named Robert L. Toner Philadelphia district manager and Peter H. Bliss as district sales representative in the Columbus area . . . M. Jerry Jones is new district sales representative for communication equipment at Redwood City, Calif.

Line Material Co's new field engineers are James R. McDonald and Philip S. Scott. McDonald will cover the southern Idaho and eastern Oregon area, with headquarters in Boise, Idaho. Scott represents the company in the western Iowa, southeastern South Dakota, and northern Nebraska area and will headquarter in Sioux City, Iowa . . . Field engineer appointments in the Central Sales Division include: L. L. Fleege, representing the firm in central Iowa, will have offices in Des Moines; Robert J. McGeever transfers from Chicago to handle Fleege's former area of eastern Iowa and northwestern Illinois, with headquarters in Davenport, Iowa; and C. W. Puent will serve in part of the Chicago and northwestern Indiana area.

Miller Co has designated Charles C. Wetmore as sales representative for Worcester-Providence territory. George Patterson will serve in the same capacity in the Memphis area.

Joseph T. Ryerson & Son, Inc. has transferred William J. Cleary from the Chicago plant to the Philadelphia steel service plant as manager of tubular steel products and cold finished steel bar sales. George B. Howell assumes a similar post at the firm's Detroit plant.

S&C Electric Co's new sales representatives for Alabama, Tennessee, and northwest Florida is Charles W. Ashby. Andrew L. Polich will represent the company in Idaho, Montana, and Oregon.

Southern States Equipment Corp has appointed John L. Hutton as manufacturer's representative in Cleveland.

Westinghouse Electric Corp has designated Lyman L. Clark sales manager of the Sunnyvale plant. He is replaced as transformer sales manager by Harry H. Humphry.

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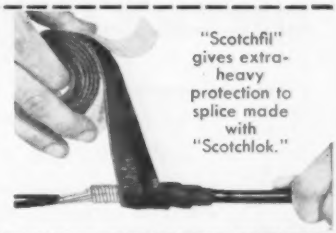

"Scotchfil" gives extra-heavy protection to splice made with "Scotchlok."

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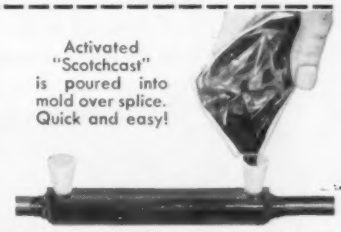

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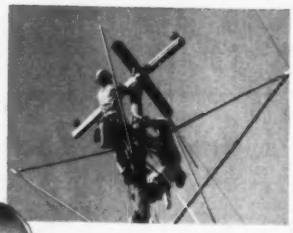

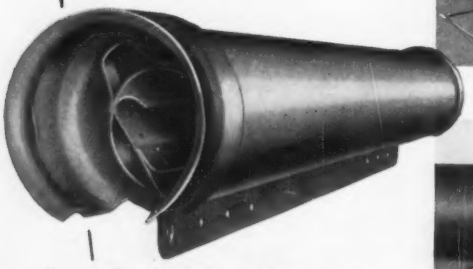

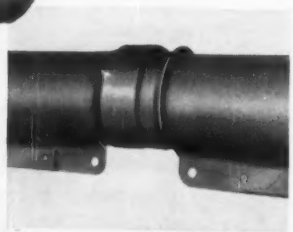

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NEWS IN BRIEF

(*Continued from page* 123)

Iowa Public Service Co plans construction of a 50,000-kw, $10-million addition to its Waterloo facilities for 1958 or 1959 operation . . . **Morro Bay power plant,** Pacific Gas & Electric Co's $44-million project in San Luis Obispo County, went into operation recently with rated generating capacity of 330,000 kw instead of the planned 300,000 kw.

Ohio Edison Co has announced plans to double the size of its two-unit, 340,000-kw Stratton plant now under construction on the Ohio River. Two additional 170,000-kw generators are planned for 1960 and 1961 operation.

REA's, CO-OP's, and MUNICIPALITIES

Rural Electrification Administration has authorized a $564,000 loan to Kay Electric Co-operative, Blackwell, Okla., for construction of 60 mi of distribution line to serve 200 new customers . . . Public Utility District No. 1 of Klickitat County (Wash.) has applied to FPC for a preliminary permit for **John Day project** on the Columbia River. Initial installation would consist of 13 units rated at 85,000-kw each.

Two co-ops have repaid REA loans in full from revenues, bring the total to five. They are United Rural Electric Cooperative of Kenton, Ohio, which borrowed $580,826; and Hendricks County Rural Electric Membership Corp of Danville, Ind, which had borrowed $990,095.

TRANSMISSION

Utah Power & Light Co and Texas Zinc Minerals Co plan a $840,000 **transmission line construction program** to bring central system electrical energy for the first time to the heart of Utah's Navajo country . . . Wyoming Public Service Commission has authorized **Pacific Power & Light Co** to construct a 59-mi, 161-kv transmission line from the Montana-Wyoming state line, southeast to Buffalo.

A $5-million contract covering **sale of TVA property** in Shelby County to Memphis Light, Gas & Water Division has been negotiated; also a 5-yr power interchange agreement.

Improved Recruiting

. . . of engineers is urged at Maryland Utilities Association meeting

Utilities must improve recruiting practices if they are to get a fair share of engineering graduates. That was the advice of Walter J. Seeley, Dean of Engineering, Duke University, speaking before the Maryland Utilities Association meet at Virginia Beach.

Overall, industry today faces a shortage of 20,000 engineers, Dean Seeley told the Maryland group. The number of engineering graduates has decreased steadily from 53,000 in 1950 to 27,500 in 1956. This has put a premium on recruiting activities. Against competition, utilities have secured only about 25% of their needs. Graduates they did get, Seeley said, were left over from other industry recruiters.

Recruiting Tips Offered

To improve recruiting efforts, Seeley gave these tips to the 200 utility men attending the meeting:

1. Place publicity in student engineering magazines stressing that utilities offer stimulating opportunities.
2. Set starting salaries near the average offering of other industries, with a scale of increases for the first five years.
3. Provide training programs lasting at least 18 months.
4. Offer opportunities for graduate study.
5. Encourage professional development.
6. Elimination of stagnating jobs.
7. Sponsor programs aimed at renewing the faith of teachers in utility engineering as a satisfying career.

Arthur R. Barnett, director of the National Association of Electric Companies, denounced the recent proposal to use revenue bonds to finance TVA expansion as a threat to Congressional control of the nature and extent of the Authority's expansion. "Granting permission to issue such bonds," Barnett said, "would be acknowledgment by Congress that TVA could extend its power system area forever." There would, Barnett said, be no force to prevent it moving into the territory of other companies.

Congressman George H. Fallon, author of the Federal Highway Act of

(*Continued on next page*)

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1956, told the Maryland Association that the Federal highway program now looks like a 20-year rather than a 13-year program as conceived. He described it as the biggest public works program ever inaugurated.

Regarding provisions for reimbursing utilities for the cost of relocating facilities, Rep Fallon pointed out that the Federal government "could not commit the States" to pay such costs. As a result, he said, the Act authorizes the States to use Federal funds to reimburse utilities *provided* state law permits this to be done and payment is not counter to any state contract.

Niagara Mohawk Plans Switch to 60 Cycles

Niagara Mohawk Power Corp has advised its industrial customers still using 25-cycle power they will have to consider conversion to 60 cycles.

Lauman Martin, company vice president and general counsel, has passed this warning along to about 200 concerns in the Buffalo area. He warned of a 10% rate increase in 25-cycle power.

Company executives made the same points to Niagara Falls 25-cycle consumers about three months ago, shortly after a rock slide crushed Niagara Mohawk's Schoellkopf Station in the lower Niagara. The slide created a deficit of about 200,000 kw in 25-cycle power, or nearly a third of the total 650,000 kw used on the Niagara Frontier.

Niagara Mohawk made up that deficit principally through a three-year contract with the Hydro-Electric Power Commission of Ontario across the river. But it costs the company considerably more to buy the power than it did to produce it.

The company said it was warning 25-cycle users to prepare for conversion because any Niagara redevelopment, whether done by private capital or some government agency, will use only 60-cycle generators.

Factories forced to replace 25-cycle motors and heating elements with 60-cycle face a heavy expense. Martin said the company is studying an assistance plan but has nothing definite to offer now.

Buffalo plants use about a third of the 650,000 kw of 25-cycle current which Niagara Mohawk produces, Niagara Falls plants the remainder.

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CENTRAL ILLINOIS PUBLIC SERVICE COMPANY
ILLINOIS BUILDING — 609 EAST ADAMS STREET
SPRINGFIELD, ILLINOIS

This information will be held in confidence
Present Employer will not be contacted without your permission

ENGINEERING - CONSTRUCTION FIRM

NEEDS AN

ELECTRIC UTILITY EXECUTIVE

A large engineering and construction firm in Eastern Penna. is looking for a man who has been, or is now, engaged by an electric utility company in the capacity of senior or junior executive.

His primary duty will be that of contacting executives and officials in the Utility field to promote relations and solicit inquiries for engineering and construction services in connection with power plant expansion programs. Applicants should be free to travel and have high order of personal responsibility in work and client relationships. Salary open.

Write outlining personal history and work experience. Please include telephone number.

P-3043—Electrical World
Classified Adv. Div.,
P.O. Box 12, New York 36, N. Y.

SALES REPRESENTATIVE

Established and growing multi-plant electrical equipment manufacturer needs representative for Maryland-Delaware territory.

This opportunity for E.E. grad. or equivalent. Should possess successful sales experience.

Salary depends on experience and qualifications. Offering bonus plan, profit sharing plan, paid vacations, sick leave.

Send resume of experience, education, etc. to

P-3145, Electrical World
Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

BOOKS AND PEDIODICALS

A.I.E.E. Transactions wanted to buy for cash and other technical and scientific periodicals. E. W. Ashley, 27 E. 21, N.Y.C. (10)

U. S. Government

DEPARTMENT OF THE INTERIOR, Bureau of Reclamation. Sealed bids (Invitation No. DS-4771) will be received at Denver, Colorado, until November 15, 1956, for furnishing one 2,400-volt, metal-enclosed, indoor-type, motor control equipment assembly for Booster Pumping Plant, Chief Joseph Dam Project, Washington. Delivery is desired within 270 days. For particulars, address Bureau of Reclamation, Building 53, Denver Federal Center, Denver 2, Colorado. W. A. Dexheimer, Commissioner.

DEPARTMENT OF THE INTERIOR, Bureau of Reclamation. Sealed bids (Invitation No. DS-4772) will be received at Denver, Colorado, until November 15, 1956, for furnishing two 230-kv (900 kv BIL), 1,200-ampere, 5,000,000-kva, 3-cycle interrupting, power circuit breakers for Sioux City Substation, Missouri River Basin Project, South Dakota. Delivery is desired within 360 days. For particulars, address Bureau of Reclamation, Building 53, Denver Federal Center, Denver 2, Colorado. W. A. Dexheimer, Commissioner.

DEPARTMENT OF THE INTERIOR, Bureau of Reclamation. Sealed bids (Invitation No. DS-4776) will be received at Denver, Colorado, until December 4, 1956, for furnishing one 25,000/33,333/41,667-kva, 110 grd Y- to 69 grd Y-kv, 3-phase, class OA/FA/FA, outdoor autotransformer with tank-mounted lightning arresters for Fargo Substation, Missouri River Basin Project, North Dakota. Delivery is desired within 270 days. For particulars, address Bureau of Reclamation, Building 53, Denver Federal Center, Denver 2, Colorado. W. A. Dexheimer, Commissioner.

REPLIES (Box No.): Address to office nearest you
c/o This publication Classified Adv. Div.
NEW YORK: P. O. Box 12 (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)
LOS ANGELES: 1125 W. 6th St. (17)

POSITION VACANT

Electrical Engineer with M. S. or B. S. and up to 5 years experience. Major oil company. To work as Staff Engineer in Production Department. Includes various Electrical Engineering Studies especially corrosion and oil field electrification problems. Replies confidential. Please submit resume of background and experience to The California Co., 800 California Bldg., New Orleans, La.

POSITION WANTED

Power Engineer—eleven years experience in operation and maintenance of modern hi-pressure central stations and industrial power plants. Thirty years old, married, seeks responsible position in domestic or foreign service. Presently located in South America, will be available in sixty days. PW-2934, Electrical World.

PROJECT ENGINEER

Project Leader for development and design of compression type connectors and fittings for power and telephone line splices and taps. Will supervise drafting and testing personnel. E. E. degree with experience in design. Offering top salary, annual cash bonus, profit sharing and pleasant living and working environment. Well established, growing midwest electrical equipment manufacturer offers this fine opportunity. Send resume, in confidence, to

P-3099, Electrical World
520 N. Michigan Ave., Chicago 11, Ill.

ENGINEER - CONSULTANT

Unusual opportunity for consultant with technical training and thorough experience in electric power utility work, including steam electric plant design and operations. State age, education, experience and general qualifications. Small recent photograph desirable. Replies considered confidential.

MIDDLE WEST SERVICE CO.
20 N. WACKER DRIVE
CHICAGO 6, ILL.
Attn: Engineering Dept.

ELECTRICAL ENGINEER

Required for Protective Relay application on generators, transformers, transmission and distribution lines within a large utility system. Knowledge required of use of symmetrical components, applications of relays and fuses, and settings of relays. University graduate with 3 years minimum experience in related fields.

Salary approximately $500.00 per month.

Apply to:

B. C. ENGINEERING Co. Ltd.
960 Richards Street
Vancouver 2, B. C.

EXPERIENCED METHODS AND PROCEDURE MAN

With public utility experience and **trained Staff Accountant** for position with stable New England firm. Apply giving full details to:

P-3171, Electrical World
Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

What Is *Your* Problem?

Do you need competent men — men experienced in the industry served by this publication? Men to fill executive, sales or technical positions? OR —are you seeking employment in any of these capacities?

The 25,000 other subscribers of ELECTRICAL WORLD are the logical ones to contact for a solution to your problem. They are identified with the same industry and speak your "language." You can get their attention — at small cost — through an advertisement here.

Write

CLASSIFIED ADVERTISING DIVISION

ELECTRICAL WORLD
330 W. 42 ST.
NEW YORK 36, N. Y.

WANTED IMMEDIATELY

EXPERIENCED PROPERTY ACCOUNTING PUBLIC UTILITY ACCOUNTANTS

For employment with large established firm which has been operating in New England over half a century. Excellent working conditions with first-class benefit program. Apply giving full particulars to:

P-3174, Electrical World
Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

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UNDISPLAYED RATE:

$1.50 a line, minimum 3 lines. To figure advance payment count 5 average words as a line.

PROPOSALS, $1.50 a line an insertion.

BOX NUMBERS count as one line additional in undisplayed ads.

DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

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The advertising rate is $14.00 per inch for all advertising apearing on other than a contract basis. Contract rates quoted on request.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page.

EQUIPMENT WANTED or FOR SALE ADVERTISEMENTS acceptable only in Displayed Style.

SEND NEW ADVERTISEMENTS TO Classified Advertising Div. of ELECTRICAL WORLD, P. O. Box 12, N. Y. 36, N. Y.

FOR SALE

5—OIL CIRCUIT BREAKERS

Whse. late type, outdoor type, De-Ion Grid, T.P.S.T., Rated 161000 V., 1200 amps., 60 cy., 3 ph., Type GO-3, Interr. Duty 1,500,000 KVA.

Fully complete—Cond. like new.

Price and further inf. upon request.

PHILADELPHIA TRANSFORMER CO.

BOX 566 DALTON, PA.

ELECTRICAL WIRE AND CABLE

—YOUR BEST SOURCE—

- for every industrial and power application
- Odd lengths—long and short—reasonably priced

One of the Largest Stocks in the Midwest

Let us quote on requirements—
send your inquiries
We'll also buy your Surplus

Branch Office:
Houston—Walnut 3-4580
FOR YOUR TEMPORARY NEEDS TRY OUR SURPLUS DIVISION

UNIVERSAL WIRE and CABLE CO.

2929 N. Paulina St. Chicago 13, Ill.
EAstgate 7-4777 Code: UNIWIRE

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10 MOTORS

WESTINGHOUSE LIFE LINE

200 H. P.
Like New

1780 RPM, 3 Phase
60 Cycle, 440 Volts
$800 each

(Subject to Prior Sale)

SABIN METAL CORP.

310 Meserole St., Brooklyn 6, N. Y.
EVergreen 1-5000

Your Inquiries to Advertisers Will Have Special Value . . .

—for you—the advertiser—and the publisher, if you mention this publication. Advertisers value highly this evidence of the publication you read. Satisfied advertisers enable the publisher to secure more advertisers and—more advertisers mean more information or more products or better service—more value—to YOU.

TRANSFORMERS

FOR SALE

3—1000 KVA Mol 11500-2400/4160Y
3—1000 KVA Mol 13200-2400/4160Y
3— 500 KVA W-H 33000-2400/4160Y
3— 500 KVA G-E 22000-2300/4000Y
3— 500 KVA G-E 13200-2400/4160Y
3— 333 KVA A-Ch 14400/14100/13800/13500/13200-240/480
8— 250 KVA G-E Ditto
3— 167 KVA W-H Ditto
3— 167 KVA Mol Ditto
6— 250 KVA W-H 22000-7200/12470Y
3— 200 KVA Mol 7200/12470Y-2400/4160Y
4— 100 KVA A-Ch 33000-7200/12470Y

Many other items in stock

TRANSFORMERS WANTED

Reliable rewind and repair service on all makes of transformers

THE ELECTRIC SERVICE CO.

5316 Hetzel St.
Cincinnati 27, Ohio

40 Years' Dependable Service

MOTOR GENERATOR SETS

K.W.	MAKE	A.C.	D.C.
1250	Westg.	6600/4160	600
1000	G.E.	12,000	600
500	Westg.	2300	275
300	Westg.	2300/440	250
400	A.C.	2300	120/240
200	G.E.	2300	250/275
200	Westg.	2300/4000	250/275
200	Ridgeway	2300	250
170	G.E.	440	125
150	G.E.	2300	125/250
150	A.C.	2300	275
150	Westg.	2300	125/250
150	G.E.	440	275
125	Cr. Wh.	4160	125
100	G.E.	2300	250
100	Al. Ch.	2300	250
100	Elec. Mch.	440	125
100	G.E.	440	125
75	G.E.	440	125

CHICAGO ELECTRIC CO.

1324 W. Cermak Rd. Chicago 8, Ill.

SUBSTATION EQUIPMENT

TRANSFORMERS

QU.	KVA	MFGR.	VOLTAGE
3	200	Pitts.	66,000—2300
3	1500	Wag.	44,000—6900/11950
3	1250	A.C.	44,000/115—460
3	75	West.	44,000—7200/12470Y
3	5000	G.E.	38100/66000—6600
4	3333	G.E.	38100/66000Y—33000
4	3125	Mol.	39900/69000Y—26600/4600Y
1	3500	West.	33000—13800, 3 Ph.
3	3333	G.E.	33000/11000—2400/7200
2	3000	Stand.	33000—4160, 3 Ph.
3	1500	A.C.	34,500—2300
3	667	A.C.	33,000—2400/4160Y
3	500	West.	34,400—13,800
4	333	Kuhl.	33,000—7200/12470Y
3	200	A.C.	34,500—2400/7200/12470Y
3	75	Wag.	33,000—240/480
1	3000	A.C.	23,380—2500/4330Y, 3 Ph.
3	2000	A.C.	25,400—13,200
3	1000	G.E.	23,310—2500/7500/12990Y
3	100	G.E.	22,000—7200/12470Y
3	50	G.E.	22,000—2300
2	3000	G.E.	13800—600, 3 Ph. Unit Sub.
3	1200	West.	13800—600, 3 Ph. Unit Sub.
1	1000	West.	13200—2300, 3 Ph. Unit Sub.
1	1000	A.C.	13800—480, 3 Ph.
3	1000	G.E.	13800—240/480
1	600	Stand	13200—2300, 3 Ph.
1	450	Penna.	13200—2400, 3 Ph. ASKAREL
3	200	G.E.	13200—2400
1	2500	A.C.	11,000—2400/4160Y, 3 Ph.
1	1500	G.E.	11,500—4000, 3 Ph.
3	125	A.C.	6900—2300
3	333	G.E.	2400/4160Y—460
3	200	West.	2400—240/480
3	150	West.	2400—230/115
1	100	G.E.	2300—575, 3 Ph.
6	50	West.	2400—114/228, Dry Type

FEEDER REGULATORS—Outdoor

1	500	West.	167 A. 34500 V. 3 Ph. STEP
1	250	A.C.	601 A. 2400 V. 3 Ph. STEP
3	96	G.E.	200/400 A. 2400 V. 1 Ph. IND
8	36	West.	150/300 A. 2400 V. 1 Ph. IND

ALSO: FREQ. CHGRS., M-G SETS, SYN. CONDENSERS, OIL CIR. BRKRS, ETC.

BREW, WOLTMAN & CO., INC.

52 Church St., New York 7, N. Y.

LARGE POWER EQUIPMENT

Prompt Stock Shipment
RENUBILT MOTORS - GENERATORS
TRANSFORMERS - CIRCUIT BREAKERS
DO YOU GET OUR STOCK LIST?

BELYEA COMPANY INC.

51 Howell St. Jersey City, N. J.

New and Used Equipment Available for

POWER PLANTS, SUBSTATIONS, TRANSMISSION LINES AND CONSTRUCTION

Send for new list to

EBASCO SERVICES INCORPORATED

APPARATUS EXCHANGE Two Rector St., New York 6, N. Y.

MOTORS · GENERATORS
TRANSFORMERS
NEW · REBUILT
WORLD'S LARGEST INVENTORY
ELECTRIC EQUIPMENT CO.
PHONE STATION COLLECT GL 6781
ROCHESTER, NEW YORK

Surplus Thermal Demand Wattmeters

SINGLE AND POLYPHASE
GOOD CONDITION
Write for Description and Prices

Duke Power Co. Charlotte, N. C.

MEETINGS CALENDAR

OCTOBER

Edison Electric Institute—Electrical Equipment Committee, Hotel Statler, Cleveland, Ohio, Oct. 15-16; Transmission and Distribution Committee, Hotel Statler, Buffalo, N. Y., Oct. 18-19; Electric Space Heating & Air Conditioning, Indianapolis, Indiana, Oct. 25-26; Wiring Promotion Committee, Cherry Hill Inn., Haddonfield, N. J., Oct. 29-30.

Inter-Industry Farm Electric Utilization Council — National Power Use Workshop, Milwaukee Auditorium, Milwaukee, Wis., Oct. 15-16.

Iowa Utilities Association—Annual Management Conference, Hotel Fort Des Moines, Des Moines, Iowa, Oct. 15-16.

American Society of Civil Engineers—Annual Convention, Penn-Sheraton Hotel (formerly Hotel Wm. Penn), Pittsburgh, Pa., Oct. 15-19.

Michigan Municipal Utilities Association—Park Place Hotel, Traverse City, Mich., Oct. 17-18.

Wisconsin Utilities Association—Annual Convention of Electric & Gas and Operating & Sales Sections, Schroeder Hotel, Milwaukee, Wis., Oct. 17-19.

Pennsylvania Electric Association—Meter Committee, Split Rock Lodge, White Haven, Pa., Oct. 18-19; Prime Movers, Garden City Hotel, Garden City, N. Y., Oct. 18-19; Communications Committee, Fort Stanwix Hotel, Johnstown, Pa., Oct. 22-23; Relay Committee, Hotel Robert Treat, Newark, N. J., Oct. 25-26.

American Institute of Electrical Engineers—Electrification of Machine Tools Conference, Sheraton-Gibson Hotel, Cincinnati, Ohio, Oct. 22-24; Farm Electrification Conference, Hotel Peabody, Memphis, Tenn., Oct. 29-31.

American Standards Association—38th Annual Meeting and 7th National Conference on Standards, Hotel Roosevelt, New York, Oct. 22-24.

University of Texas—Ninth Power Distribution Conference, University Batts Auditorium, Austin, Tex., Oct. 22-24.

National Safety Council—44th National Safety Congress & Exposition, Chicago, Illinois, Oct. 22-26.

National Association of Corrosion Engineers—South Central Region Meeting, M & M Building, Houston, Texas, October 23-26.

Oklahoma Utilities Association—Electric Light & Power Division, Western District, Chickasha, Okla., Oct. 25; Eastern District, Poteau, Okla., Oct. 26.

Northwest Public Power Association—Third Annual Workshop of Power Use Section, Franklin PUD Auditorium, Pasco, Wash., Oct. 25-26.

Montana State Rural Electric Cooperative Association—Annual Meeting, Lewiston, Mont., Oct. 29-31.

Electrical Management Society—Hotel Sherman, Chicago, Ill., Oct. 31-Nov. 2.

NOVEMBER

Pensylvania Electric Association—Transmission and Distribution, Shenango Inn, Sharon, Pa., Nov. 1-2.

Edison Electric Institute—Sales Personnel & Training Committee, New York, N. Y., Nov. 2; Commercial Lighting Committee, Shoreham Hotel, Wash., D. C., Nov. 8-9; Industrial Relations Committee, EEI Headquarters, New York, N. Y., Nov. 15; Industrial Power & Heating Group, Detroit, Mich., Nov. 15-16; Accident Prevention Committee, Statler Hotel, Hartford, Conn., Nov. 26-28.

National Rural Electrification Cooperation—Region Nine Annual Meeting, Davenport Hotel, Spokane, Wash., Nov. 12-13.

National Electrical Manufacturers Association—Annual Meeting, Traymore Hotel, Atlantic City, New Jersey, Nov. 12-16.

Pacific Coast Electrical Association, Inc—Administrative Services Section, Hotel Biltmore, Santa Barbara, Calif., Nov. 14-15.

American Society of Refrigerating Engineers—43rd Semiannual Meeting, Hotel Statler, Boston, Mass., Nov. 25-28.

• **Inland Empire Waterways**—23rd Annual Convention, Chinook Hotel, Yakima, Washington, Nov. 26-27.

American Society of Mechanical Engineers—22nd National Exposition of Power and Mechanical Engineering, Coliseum, New York, N. Y., Nov. 26-30.

• **Third International Automation Exposition**—New York Trade Show Bldg., N. Y., Nov. 26-30.

Great Lakes Conference of Railroad and Utilities Commissioners—First Annual Convention, Greenbrier Hotel, White Sulphur Springs, W. Va., Nov. 29-30.

DECEMBER

Institute of Radio Engineers—2nd Instrumentation Conference, Biltmore Hotel, Atlanta, Ga., Dec. 5-7.

Edison Electric Institute—1957 Conference Planning Committee, sponsored jointly with American Gas Association, EEI-AGA Headquarters, New York, Dec. 6-7; Street Lighting Committee, Dayton, Ohio, Dec. 6-7; Commercial Cooking & Water Heating Committee, Cleveland, Ohio, Dec. 13-14.

JANUARY, 1957

Doble Engineering Co—24th Annual Conference of Doble Clients, Sheraton Plaza-Hotel, Boston, Massachusetts, January 14-18.

American Institute of Electrical Engineers—Winter General Meeting, Hotel Statler, New York, Jan. 21-25.

Missouri Valley Electric Association—Industrial & Commercial Sales Conference, Hotel President, Kansas City, Mo., Jan. 31-Feb. 1.

FEBRUARY

National Association of Purchasing Agents—26th Annual Mid-Winter Conference, Public Utility Buyers' Group, Brown Hotel, Louisville, Ky., February 3-5.

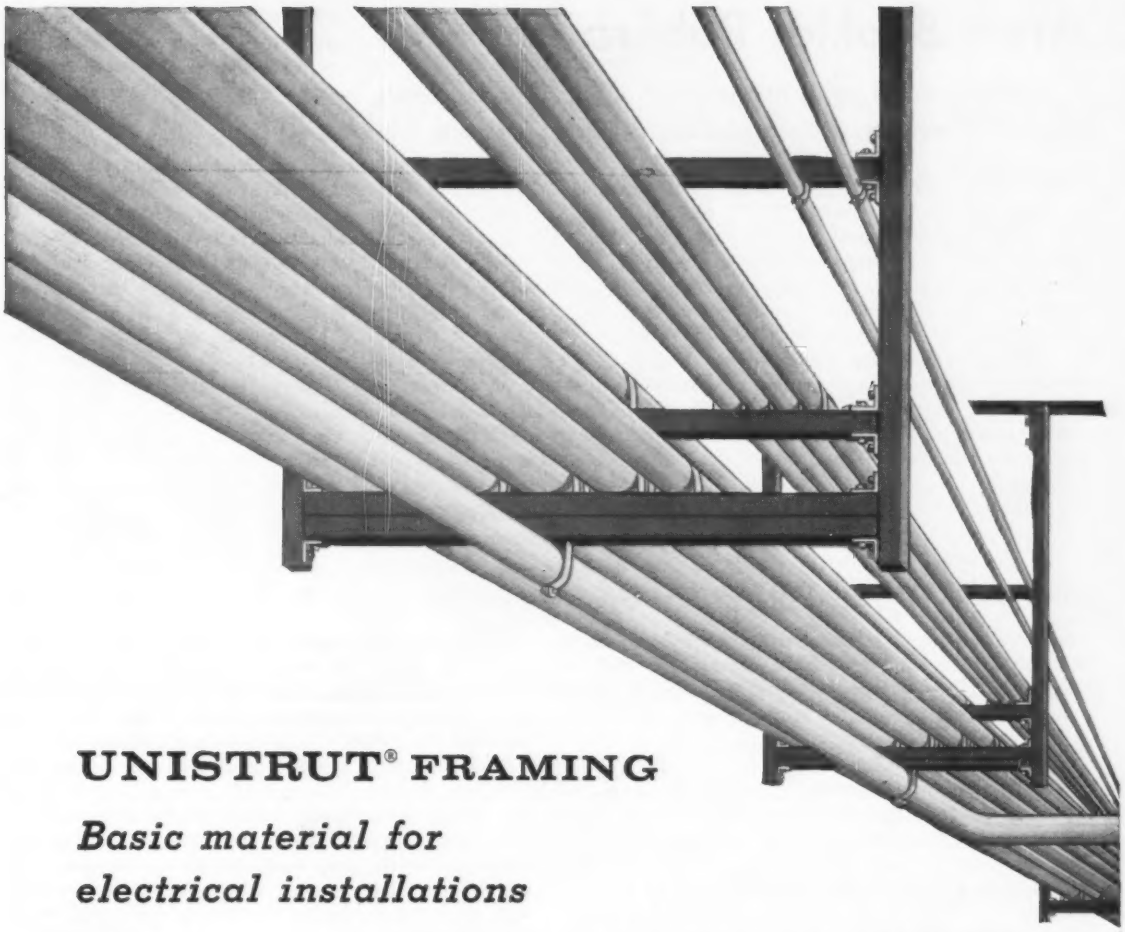
Electric Institute of Washington—Electrical Trade Conference & Exposition, Shoreham Hotel, Washington, D. C., February 12-14.

American Society of Heating and Air-Conditioning Engineers—63rd Annual Meeting, Chicago, Ill., Feb. 25-28.

• Additions this week.

Baker River Project Approved by FPC

Federal Power Commission has granted Puget Sound Power & Light Co a 50-year license for its proposed 85,000-kw, two-generator Upper Baker River development and its existing Lower Baker River project. Latter project, which now has installed capacity of 39,500 kw, will add a 55,000-kw generating unit after Upper Baker River development is constructed.



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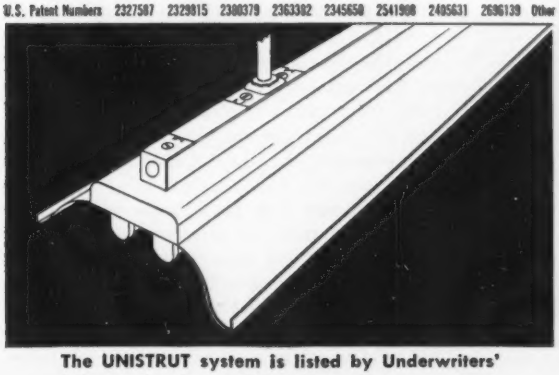
Basic material for electrical installations

World's Most Flexible All-Purpose Metal Framing.

For supporting conduit and cable in any installation, UNISTRUT offers the quickest, simplest assembly. It makes a clean, professional installation and is strong enough to support the heaviest run. With UNISTRUT Channel and Concrete Inserts even the trickiest installation is simplified. Capacities may be easily expanded to take care of future growth. All types of fittings, clamps and brackets are available. See your UNISTRUT distributor. Write for new Bulletin FF-5.

UNISTRUT PRODUCTS COMPANY, Dept. W-10
933 W. Washington Blvd., Chicago 7, Illinois

U.S. Patent Numbers 2327587 2329815 2380379 2363302 2345650 2541908 2405631 2696139 Other Patents Pending



The UNISTRUT system is listed by Underwriters' Laboratories, Inc. and may be used as a raceway.

Quickly installed, UNISTRUT Channel is rigid and strong, giving perfect, permanent alignment.

Atom Booklet Published

Other recent publications cover public utility statistics, maps of generating stations and transmission lines facts

Here are several publications now available to the utility industry:

Chamber of Commerce of the United States has prepared "The Atom in Your Community," an easy-to-understand 24-page booklet for popular consumption. It covers such topics as "why is atomic-electric power important?" "what is the safety problem in controlling radiation?" "is there any danger that a power reactor will explode like an atom bomb?" and "radio-isotopes and what they do." Bulk order rates on request from the Chamber's Department of Manufacture and industrial Development, Washington 6, D. C.

(Con Edison Co of New York published its own booklet about its Indian Point nuclear plant to be built soon. Samples available.)

Federal Power Commission has announced the issuance of "Statistics of Electric Utilities in the United States, 1954, Publicly Owned" at $2 a copy.

Federal Power Commission also has issued the 1956 edition of its map series, "Principal Electric Utility Generating Stations and Transmission Lines in the U. S." Set includes 12 regional maps and four enlarged-scale maps of congested areas. Utilities are identified by class of ownership (public, private, mutual, or industrial) and maps show lines of 22 kv and above, stations of 1,000 kw and above, and industrial stations of 1,000 kw and above when interconnected with an electric utility. A territorial map covers Alaska, Puerto Rico and Hawaiian Islands. Price: $5 from Office of Public Reference, FPC, Washington 25, D. C. Order FPC-M-47.

Electric Companies Public Information Program has published "Fact Finder," a 168-page illustrated book. Latest facts and figures are included. Write ECPIP, 2 West 45th St., New York 36. Price: $5.

Moore Plant to Give 150 Mw (*Continued from page* 132)

breaker, following a service transformer failure, service is restored to a dead bus section. Transformer and bus sectionalizing breakers are electrically interlocked to avoid tying generators through the station system.

Air Cools Generators

For cooling the generators and heating the main part of the powerhouse, outside air is drawn through adjustable louvers in the downstream wall and one end wall of the building. The air is then drawn into the individual machines, each generator requiring 80,000 cf of air per min. A total of fifty-four 20 x 25-in. 2-in. thick washable filters cleans the air before it enters the generator.

Fans for circulating air are mounted on the generator rotor and operate at about 1¾-in. water pressure. Air, having passed through the rotor and stator coils, is discharged through the sides of the stator frame into an air duct and then outside the building through adjustable louvers in the upstream wall. This obviates recirculation of air in warm weather. At other times, dampers in the discharge air duct and generator room floor allow warm air to be discharged within the powerhouse for heating and then to recirculate through the generators. A study of the relative merits of water-cooled vs air-cooled generators did not show any economy for the former.

The Moore machines, along with those at Comerford, provide the bulk of the frequency regulation for the whole interconnected power system area east of Buffalo and north of New York City, by automatic load control equipment operated with tie-line bias.

Tee Connectors Eliminated

All 230-kv, 34.5-kv (for local areas), and 15-kv switching structures are outdoors. The 230-kv structure of latticed steel with overhead shielding wires has a minimum phase-to-phase spacing of 18 ft, with twelve 10-in. disc insulators in each suspension string. The low-voltage switching structure has 15-kv station post-type insulators with copper-tube conductors. Each 230-kv transmission circuit at the switchyard includes a 196-kv "zig-zag," special, self-supporting type lightning arrester with minimum space and simple mounting arrangements. Side-opening sleet-thawing switches with 9-in. open-gap distance and motor-operated transformer clearing disconnects are mounted on 196-kv station post-type insulators. Transformer neutral bus supports are of 69-kv insulation class.

Substitution of preformed aluminum-grip deadends for tee connectors facilitated use of 350-MCM transmission conductors with an insulated steel core for thawing. Tee connectors would have made difficult and expensive the maintenance of insulation continuity within the transmission conductor throughout the connections in the 230-kv station wiring.

Single-Phase Units Used

The selection of the main power transformers was made after comparing 3-phase with single-phase units and self-cooled with water-cooled and forced-cooled units. The comparison included capitalizing losses and effect on transient stability, as well as installed cost. The economic balance turned on the availability of a spare single-phase, water-cooled transformer from Comerford. Cooling water for the transformers is pumped from the tailrace. The emergency stand-by pump is also on hand. Emergency cooling water can be obtained from the turbine scroll cases through throttling valves.

To minimize the possibility of a transformer failure resulting from a cooling coil leak, a special design was developed. First, the cooler was placed in a compartment separate from the main transformer tank to prevent a jet of water impinging on the transformer insulation. Second, straight parallel tubes, instead of a coil in the cooler minimize pressure drop through the tubes. Third, nitrogen gas pressure over the transformer oil will be operated at 2 instead of the usual 0.5 psi minimum, to increase the chances of the oil pressure outside the cooling tubes always exceeding that within, the outlet pressure being atmospheric. Hence, any leak developing within the tubes will tend to result in oil passing into the water, rather than water into the oil.

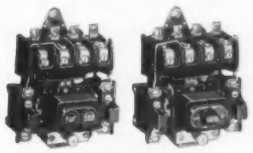
OILTIGHT CONTROL ACCESSORIES
START BUTTON
SELECTOR SWITCH
WING LEVER SELECTOR
COIN SLOT SELECTOR
PILOT LIGHT
Eight button control station built into Cleereman drill press equipped with A-B oiltight buttons. Allen-Bradley also lists a line of surface mounted stations
CLEEREMAN
Cleereman drill press is factory equipped with the special A-B automatic motor control panel shown here, using strictly standard components

FOR DEPENDABLE AUTOMATION • • STANDARDIZE ON ALLEN-BRADLEY CONTROLS

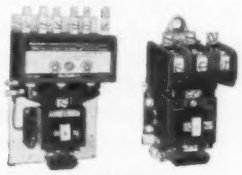
Control panels for an automation line of special machinery must be ultradependable to make the installation a success. The failure of a single item in the control sequence may shut down the entire production line. That is why all electrical and magnetic components must be good for *millions of trouble free operations.*

A-B Quality

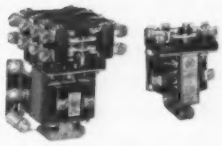
All Allen-Bradley control components, of which a few are shown below, have been time-tested in thousands of industrial applications. They are QUALITY products designed for trouble free service in the toughest automation layouts. Permit us to discuss your control requirements with you. Call on the nearest Allen-Bradley district office.



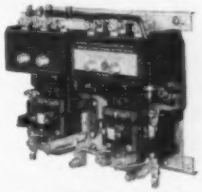
SOLENOID STARTERS
With push buttons • with selector
The Form 2 construction is for remote control



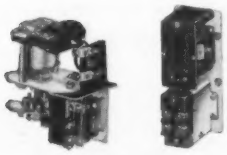
CONTACTORS
From one to eight poles
Ratings up to 1000 amps



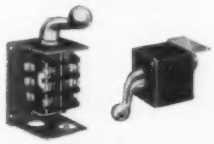
SOLENOID RELAYS
In a wide variety of types



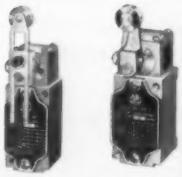
REVERSING STARTERS
Up to 600 hp, 440-550 v



TIMERS
Motor-driven • pneumatic
Other types available



DRUM CONTROLLERS
Up to 500 hp, 440-550 v



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A complete line

TERMINAL BLOCKS
Interlocking to any length

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READERS FORUM

An Unsung Hero Sung

To the Editor:

Congratulations to you and your staff for the timely and comprehensive article and recent supporting editorials highlighting the potential market for profitable commercial electric cooking.

Your introduction of an "Index of Sales Management Performance" is of particular interest to us.

We hope your follow-up editorials will emphasize the fact that the cost impact of increasingly unprofitableable electric air conditioning load is substantially reduced when electric commercial cooking (with so much less waste heat) is substituted for fuel cooking equipment. This, by the way, is equally true in apartment houses where electric ranges and individual water heaters replace gas and oil appliances.

Because your splendid array of data on commercial cooking seems to point conclusively to the fact that industry progress in this field, got its real start during the years 1945 and 1946, may I be forgiven for taking the liberty of expressing my regret that you have thus far overlooked the "by-line credit" so fully deserved by that "unsung hero", Mr. John C. Sharp, president of the Hotpoint Co, whose 1945-1946 industry presentation "Some Economic Aspects of Commercial Cooking Loads" sparked the activities which have resulted in the accomplishments reported in your recent excellent articles on commercial cooking.

In our opinion, the conclusions deduced by Mr. Sharp ten years ago, are even more valuable today to our industry's new business and sales promotion departments than they were a full decade ago.

William S. Leffler
Engineers Associated

17 Baywater Drive
Noroton, Conn.

Some Facts on Carbon Monoxide

To the Editor:

On page 21 of the Aug. 20 issue is an article which contains some errors.

The second paragraph, first sentence contains the first error. Carbon monoxide is odorless. Any garlic-like odor must have been observed in smelling artificially odorized manufactured gas. In the third paragraph, another. It is a poorly operating automobile that puts out 7% CO in the exhaust.

In the fourth paragraph, some more errors. "Illuminating gas" contains major portions of carbon monoxide only if it is artificially produced from hot coke and steam then given "illuminating" properties by injection of "illuminants". The straight gas would have no "illuminating" properties. Smoke from burning coal would never contain 16% carbon monoxide.

In the fifth paragraph how much carbon monoxide is represented by 40 to 50% concentration on the blood. The doctor probably means 40 to 50% of the normal oxygen level.

The doctor missed one very dangerous source of carbon monoxide. Too often, workman use compressed air, from oil-lubricated compressors, to ventilate the close space they might be working in, little realizing that this air may very well carry fatal quantities of carbon monoxide in it.

Frank U. Neat

Riviera Beach
Pasadena P. O., Maryland

• At least we will all agree carbon monoxide is dangerous, and we must guard against it.

More Support for a Steering Committee

To the Editor:

Congratulations on the editorial in the Aug. 20 issue entitled "Needed: A Steering Committee for Live Better Electrically".

We, here, have been very much interested in this "Live Better Electrically" program but have honestly felt there is a definite lack of coordination in the activity. Certainly this whole idea is something all of us should support very actively and, I am sure that most of us will do just that, enthusiastically, if we can find out exactly what is wanted.

I certainly hope your editorial is taken seriously and results in some action.

Louis J. Ott
Vice President and
General Sales Manager

Ohio Brass Co
380 North Main St
Mansfield, Ohio

Chudoff Coverage Praised

To the Editor:

I have read with a great deal of interest your articles on the Chudoff hearings, and I want to congratulate you on them. I have had a number of letters from people throughout the country telling me that they read Electrical World's coverage of the hearings. Many thanks.

Colin W. Raff

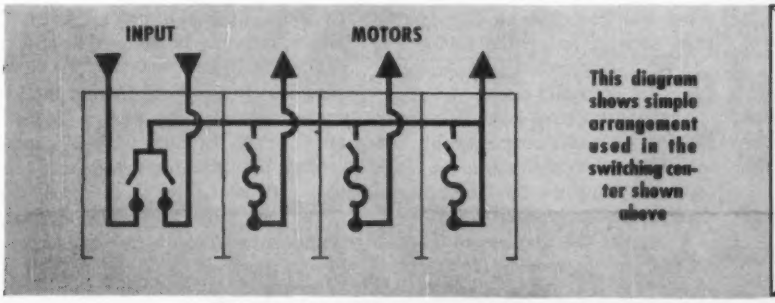
Montana Power Co
Electric Building
Butte, Montana

The man with his coat off is Carl Christiansen, 3E Sales Engineer, pointing out the features of a 3E Switching Center built for a large automobile manufacturer.

3E builds to meet the specs . . .
. . . *no need to compromise*

3E engineering and standard components solve a wide range of unique requirements.
There is often a temptation to sacrifice a measure of efficient design in favor of easily available standard units. At 3E we believe that equipment engineered to fit job requirements without compromise is not only economical —it is the best way to protect *your responsibility for safe precise control of power.*

The switching center shown above was built for a major auto manufacturer. It is typical of the many cases where there is *no standard package* that can do the job. The unit handles a 4800 volt input distributed to two 300 H.P. motors and one 200 H.P. motor used to drive high frequency generators. The use of 3E's **Auto Speed Load Interrupter Switches** and 3E design produced a compact, rugged switching center at a practical cost.



This diagram shows simple arrangement used in the switching center shown above

3E

ELECTRICAL ENGINEERS EQUIPMENT CO. Melrose Park, Illinois
Representatives in principal cities—in Canada by Power-Lite Devices, Ltd.

Depreciation Rulings Favorable

Pennsylvania commission is only body to deny utilities use of tax savings accruing from accelerated depreciation

Two years have passed since Congress enacted the 1954 Revenue Bill which, provided for the liberalization of depreciation provisions. There is no doubt that this piece of legislation was to apply equally to both segments of American industry—the regulated and that which is controlled by the forces of a free market economy. Congressional intent was expressed clearly enough when the House Committee on Ways and Means, in their hearings on the Internal Revenue Code of 1954, said: "For all segments of the American economy, liberalized depreciation policies should assist modernization and expansion of industrial capacity, with resulting economic growth, increased production, and a higher standard of living."

What is the record to date? As far as electric utilities are concerned, 21 state public service commissions have issued 31 accounting orders. Of this number, 16 prescribed a reserve method of accounting for the deferral on the balance sheet while 15 ordered utilities to use a restricted or appropriated surplus.

In addition, for rate-making purposes only, the Public Service Commission of Indiana in the rate proceedings of the Public Service Co of Indiana, in an order dated Mar. 3, 1956—ruled that for rate-making purposes normalized taxes are to be used since, as the commission pointed out, only in that manner could the intent of Congress be effectuated for the utility industry.

In addition, there are several rulings of great importance to the electric utility industry which were with respect to other utilites. One of these was an order of the Oklahoma Corporation Commission with respect to the Oklahoma Natural Gas Co wherein the commission ordered the company to normalize taxes and allowed them to use the deferral in such manner as "may be determined by management . . . to be good business practice." On the other hand, the Pennsylvania Public Utility Commission in the case of Manufacturers Light & Heat Co and the Citizens Water Co of Washington, Pa., ordered actual taxes to be used and thus deprived both utilities of any benefits whatsoever which the law intended them to have. This is the only regulatory body to adopt this course.

Amere Gas Order Important

Finally, an order of the greatest importance to all the industry was the order of the Federal Power Commission, in the case of Amere Gas Utilities Co wherein the chief presiding examiner ruled that the company was to retain the benefits of liberalized depreciation by noting that there was no fundamental difference between liberalized depreciation and accelerated amortization and that "If depreciation for book and rate purposes were continued on a straight-line basis but liberalized depreciation were taken for tax purposes, the amounts chargeable to tax expense would be less and, under such circumstances, there might result a reduction in rates. But in that instance the Congressional purpose would be completely defeated."

While the majority of the FPC affirmed this order (one commissioner dissented) it is interesting to note that this regulatory body appears to doubt the wisdom of the incentives provided by Section 167 for public utilities when it said: "The extraordinary ability and willingness of natural gas companies, including petitioners, to attract capital and construct new facilities causes us to question whether the incentive provided by Section 167 of the Internal Revenue Code is necessary or desirable for this industry or will, in the long run, be as beneficial to the public interest as is the present, traditional method of treating depreciation expense.

"We are calling this situation to the attention of the Congress by transmit-

(*Continued on page* 286)

Court Upholds Non-uniform Tax

A levy of up to 5% on gross receipts of utilities by Illinois municipalities has been upheld by the Illinois Supreme Court. The law had been signed by Gov William G. Stratton in July, 1955.

Peoples Gas, Light & Coke Co had appealed a lower court decision ruling the law unconstitutional.

The company filed suit in Circuit Court last January. It challenged the law on the ground that the Chicago ordinance imposing the levy did not apply uniformly on different types of utilities.

The law went into effect last January. It imposes a gross receipts tax of 5% for Peoples Gas; 2% on the Illinois Bell Telephone Co and 1% on the Commonwealth Edison Co.

This levy was immediately passed on to the customers as follows:

- 5.6% by Peoples Gas.
- 2.4% by Illinois Bell.
- 0.92% by Commonwealth Edison.

The monies the utilities have collected from this source have been kept in special funds and total $3,097,149 for Peoples Gas; $2,055,188 for Illinois Bell, and $954,506 for the Commonwealth Edison.

The state court upheld the difference in the tax rates by saying that different producing situations of the utilities do away with the necessity for a single tax classification.

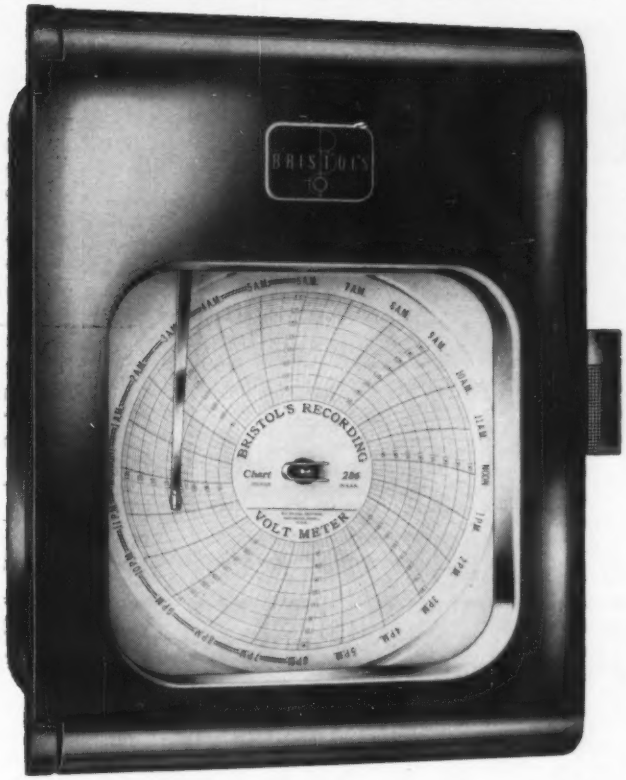
Telephone and electric utilities were taxed less than Peoples Gas in Chicago because they were paying 3% and 4%, respectively, on gross receipts for franchise taxes.

Similar suits have been filed by the Illinois Bell and Commonwealth Edison. They were pending in the lower courts awaiting the final outcome of the Peoples Gas case.

A Peoples Gas spokesman has said his company is studying the State Supreme Court's decision to decide whether or not to appeal to the U. S. Supreme Court.

WHAT'S NEWS AT BRISTOL . . .

How do you pick the right recording ammeter or voltmeter?



PERMANENTLY MOUNTED Bristol Voltmeters and Ammeters come in three models: interchangeable surface and flush, surface-panel, and flush panel.

The *right* choice for any voltage or current measurement and recording job is a Bristol Series 500 instrument.

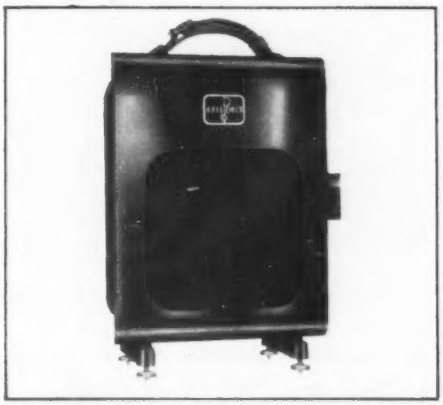
Why Bristol? Mainly because for sheer accuracy the Bristol Recorders can't be topped. Among the reasons for that are:

1. Low burden – the lowest burden of any round-chart recorder on the market.
2. Extremely high torque gradient.
3. Temperature compensated.
4. Shock-proof moving element mounting.
5. Leveling of instrument not critical.
6. Continuously legible recording of sudden changes – up to full scale value.

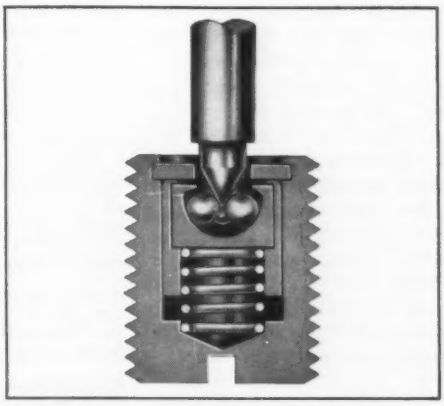
Also, Bristol's Series 500 Voltmeters and Ammeters are designed for easy use, with dust- and moisture-proof cases; quick-set chart hub for each chart changing; and snap-on chart plate.

Models offered that comply with ASA Specification C39.2.

Want more facts? Write for Bulletin E1111 to the Bristol Company, 116 Bristol Road, Waterbury 20, Conn. 5.19



SINGLE AND TWO-PEN PORTABLE BRISTOL RECORDERS are offered in two models: one chiefly for portable pole mounting and the other for general portable service.



NEW BALL-BEARING SUSPENSION, loaded by a coil spring, prevents damage even under severe mechanical shock. Corrosion-resistant stainless steel ball bearings are almost tool-hard.

BRISTOL

TRADE MARK BRISTOL'S REG U.S. PAT. OFFICE

POINTS THE WAY IN HUMAN-ENGINEERED INSTRUMENTATION

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

Court Upholds Tax

(*Continued from page* 284)

ting copies of the presiding examiner's decision, our opinion herein, and the dissenting opinion attached hereto, to the chairman of the Finance Committee of the Senate and the chairman of the Ways and Means Committee of the House."

There is no question that the foregoing statement, coming as it does from one of the most influential of the regulatory commissions, will undoubtedly make the task of utilities, seeking equitable treatment for rate-making purposes where the tax deferral under Section 167 is involved, that much the harder.

Pacific P&L Fails to Get Vote For Buying Co-op

Members of the Shoshone River Power Inc of Cody, Wyo., voted against selling its facilities to Pacific Power & Light Co.

Craig Thomas, president of the REA cooperative, said the vote was 154 to 132 in favor of the sale—short of the two-thirds majority needed for approval.

The proposed sale created wide interest after the Wyoming Rural Electric Assn charged that it would have been a "sell out" to private power enabling Pacific to obtain the property for nearly 50¢ on the dollar.

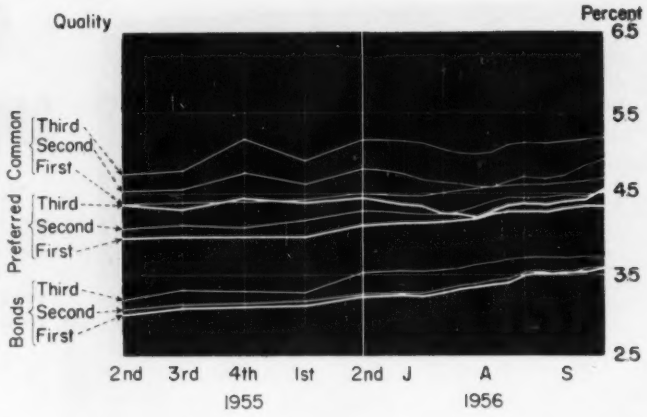
Pacific had offered to pay $843,000 for the cooperative and the Rural Electric Assn estimated that Shoshone River Power's plant and transmission lines were valued at $1.5 million.

The Rural Electric Assn claimed the sale would have set a precedent in Wyoming that could start a trend to turning over all of the state's 15 rural cooperatives to private utilities.

RATE BRIEF

New York Public Service Commission will hold hearings November 9 on a proposal by **Consolidated Edison Co of New York** to cancel consolidated billing of electric, gas, and steam service to customers who own or lease several adjacent buildings.

Today's Utility Yields (%)



	Bonds			Preferred Stocks			Common Stocks		
Quality	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
Oct. 4	3.59	3.60	3.72	4.36	4.49	4.71	4.56	4.89	5.24
Sept. 27	3.60	3.61	3.72	4.35	4.52	4.70	4.54	4.94	5.20
Sept. 20	3.57	3.58	3.74	4.35	4.45	4.68	4.44	4.84	5.15

Utility Earnings . . .

Company	Period Months Ended		Net Income 1956	Net Income 1955	Earnings Per Common Share 1956	Earnings Per Common Share 1955
Arkansas Power & Light	12	Aug.	$5,802,916	$5,741,182	$.....	$.....
Baltimore Gas & Electric	8	Aug.	11,521,000	10,011,000	1.68(a)	1.55(a)
Central Illinois Public Service	12	Aug.	9,196,143	8,532,621	2.47	2.27
Central Maine Power	12	Aug.	6,372,540	6,647,179	1.65	1.74
Central Vermont Public Service	12	Aug.	1,369,165	1,426,585	1.23(a)	1.31(a)
Consumers Power	12	Aug.	31,140,934	27,917,132	3.32(a)	3.11(a)
Dallas Power & Light	12	Aug.	7,820,764	7,033,050	.....	.....
Iowa Southern Utilities	12	Aug.	1,461,079	1,341,360	1.78	1.63
Kansas City Power & Light	12	Aug.	9,104,682	7,495,891	2.77	2.25
Middle South Utilities, consolidated	12	Aug.	15,848,832	14,500,142	2.09	1.91
Montana Power and subsidiaries	12	Aug.	8,891,692	8,329,140	3.10	2.87
Ohio Edison and subsidiary	12	Aug.	24,337,325	22,408,176	3.72	3.39
Pennsylvania Power	12	Aug.	2,942,104	2,772,495	.....	.....
Pennsylvania Power & Light	12	Aug.	24,185,722	21,824,865	3.44	3.05
Portland General Electric	12	Aug.	5,055,986	4,847,656	1.69	1.62
Public Service of Indiana	12	Aug.	13,415,528	12,510,578	2.43(b)	2.41(b)
Public Service of New Hampshire	12	Aug.	4,164,465	4,161,132	1.21(a)	1.36(a)
South Carolina Electric & Gas	12	Aug.	5,422,818	5,090,215	1.41(a)	1.37(a)
Southern Indiana Gas & Electric	12	Aug.	2,331,558	2,541,448	1.93(c)	2.33(c)
Texas Electric Service	12	Aug.	12,382,077	10,590,614	.....	.....
Texas Power & Light	12	Aug.	11,291,965	10,276,160	.....	.....
Texas Utilities, consolidated	12	Aug.	26,953,825	24,254,922	2.21(f)	2.05(f)
Utah Power & Light and subsidiary	12	Aug.	7,558,698	6,618,270	3.40	3.24
Virginia Electric & Power	12	Aug.	20,375,806	18,810,852	2.69	2.51
Western Light & Telephone	12	Aug.	1,757,951	1,474,243	3.04(g)	2.56(g)
Western Penn Electric, consolidated	12	Aug.	17,734,769	16,887,786	2.09	1.99

Notes—(a) Based on average number of shares outstanding; (b) Based on 4,485,228 shares in 1956 and 4,251,060 shares in 1955; (c) Based on 996,363 shares in 1956 and 913,333 shares in 1955; (f) Based on 12,210,000 shares in 1956 and 11,810,000 shares in 1955; and (g) Based on 494,924 shares in 1956 and 458,172 shares in 1955.

Line patrol. The Universal 'Jeep' carries patrol and service crews and equipment along the right of way to structures in off-road locations. It travels in conventional 2-wheel drive at highway speeds, but shifts easily into 4-wheel drive for extra traction to go through mud, soft earth, sand or heavy brush—or climb steep grades—where other vehicles can't go.

How 'Jeep' vehicles cut costs on construction and service jobs

Maintenance. The 4-wheel drive 'Jeep' Truck takes repair crews and equipment wherever they're needed, on or off the road. With the extra traction of its 4-wheel drive, it gets through to trouble spots when storms or other emergencies knock out service.

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From line installation through maintenance and other service activities... the electrical industry is served on job after job 24 hours a day by 4-wheel drive 'Jeep' vehicles.

With the extra traction of their 4-wheel drive, 'Jeep' vehicles take crews and equipment off the road, right to the tower or substation, wherever service is required.

'Jeep' vehicles with power take-off operate a wide range of equipment, including generators... compressors... mowers ...post hole diggers... winches... and many more.

Learn how the electrical industry uses multi-purpose 'Jeep' vehicles for hundreds of different jobs, from installing meters to stringing high lines, and how these vehicles save owners money through long life and low maintenance costs. See your Willys dealer today, or write for information.

The 'Jeep'®

family of 4-wheel drive vehicles

WILLYS... makers of the world's most useful vehicles

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EAST or WEST... you get prompt delivery with

CF&I GALVANIZED STEEL STRAND

Need top-quality three- or seven-wire galvanized steel strand for guy, messenger, or overhead ground wire? Then, no matter what part of America you're in, one of our two modern plants—at Pueblo, Colorado or Buffalo, N. Y.—will quickly and efficiently fill your strand requirements.

What's more, in addition to prompt delivery, you're always sure of the quality of CF&I Galvanized Steel Strand. Every phase of its production is under the CF&I rigid quality control system . . . every phase of its production is supervised by the manufacturers of world-renowned Wickwire Wire Rope and Wire Rope Slings.

When you need strand—to your own or ASTM Specifications A-122 or A-363—it'll pay you to contact your nearby CF&I sales office.

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THE COLORADO FUEL AND IRON CORPORATION

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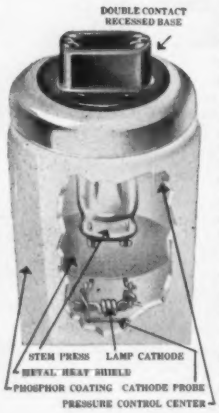
Sylvania's VHO lamp makes possible more light per foot from fluorescent lamps

Produces more than twice the light output of conventional 40 watt lamps!

Sylvania Research conquers Heat and Pressure—two major obstacles to more light per foot!



The VHO-lamp represents an entirely new concept in lamp design—an entirely new way to get more light per foot from fluorescent lamps.

To make this achievement possible Sylvania engineers have developed and combined these vital features:

1. New "Pressure Control" Center. The specially developed, exclusive internal end construction of the VHO lamp creates "cool spots" at each end which allow mercury to condense.

2. Neon gas replaces Argon. Sylvania discovered that Neon actually gives far greater efficiency at higher wattages than the conventional Argon.

3. Use of standard T-12 bulb. The popular T-12 bulb permits maximum effective production and use of ultraviolet radiation within the tube.

4. The Patented Sylvania Rapid Start System. This development for fluorescent lamps keeps filaments warm during operation of lamp, and encourages effective electronic emission from filaments at all times.

IN APPEARANCE, the VHO-25 is a standard 4-foot T-12 lamp, yet it produces *more than double* the light output of 40-watt fluorescent lamps made until now.

Due to the substantially greater light output of the Sylvania VHO, High-Bay Industrial Fluorescent lighting becomes practical and economical. In Low Bay lighting, VHO lamps will, in many cases, prove more economical because fewer fixtures are required.

VHO lamps are also a new and practical answer to better, highly efficient street lighting . . . use a minimum of lighting units of less cumbersome size. They are also particularly suitable for other outdoor lighting applications such as store fronts, service stations, and floodlighting of outdoor industrial or commercial areas.

If you are considering plans which include lighting for new construction or modernization, the new Sylvania VHO fluorescent lamp will be of particular interest to you. For complete details consult your local Sylvania Representative, or send today for your free folder about the revolutionary Sylvania VHO Rapid Start Fluorescent Lamp. Write to:

SYLVANIA ELECTRIC PRODUCTS INC.
Lighting Division, Dept. E, Salem, Mass.
In Canada: Sylvania Electric Products (Canada) Ltd.
Shell Tower Building, Montreal

SYLVANIA

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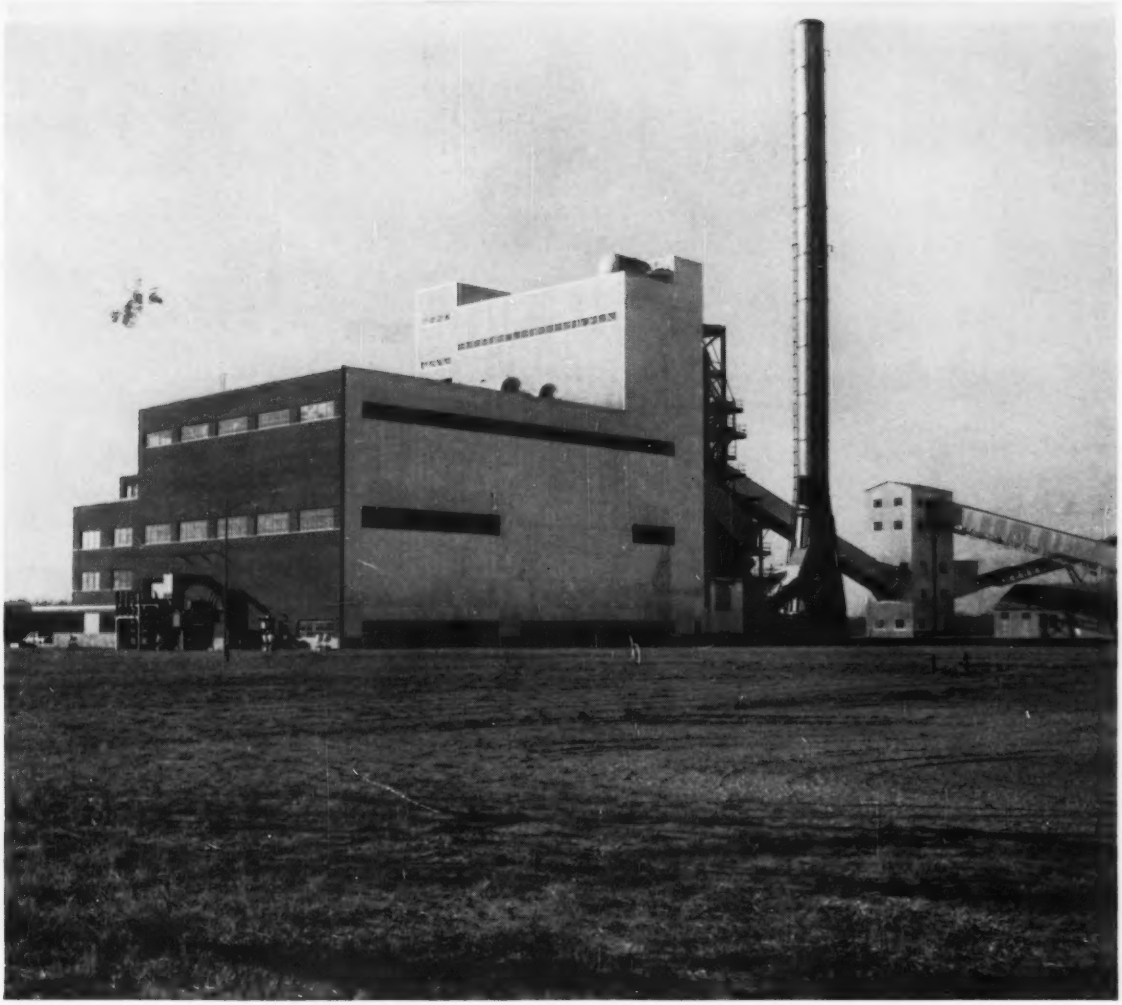


IOWA POWER & LIGHT COMPANY Power Station #1 Unit, Council Bluffs, Iowa

Leading Power Companies Use Exide Batteries

Typical of America's myriad power generating plants upon which whole communities depend is the Iowa Power & Light Station # 1 Unit, Council Bluffs. This one plant, with its 40,000 kilowatt capacity, and linked with other generation plants throughout the Iowa Power & Light properties, assures a continuity of service to all Iowa Power & Light users.

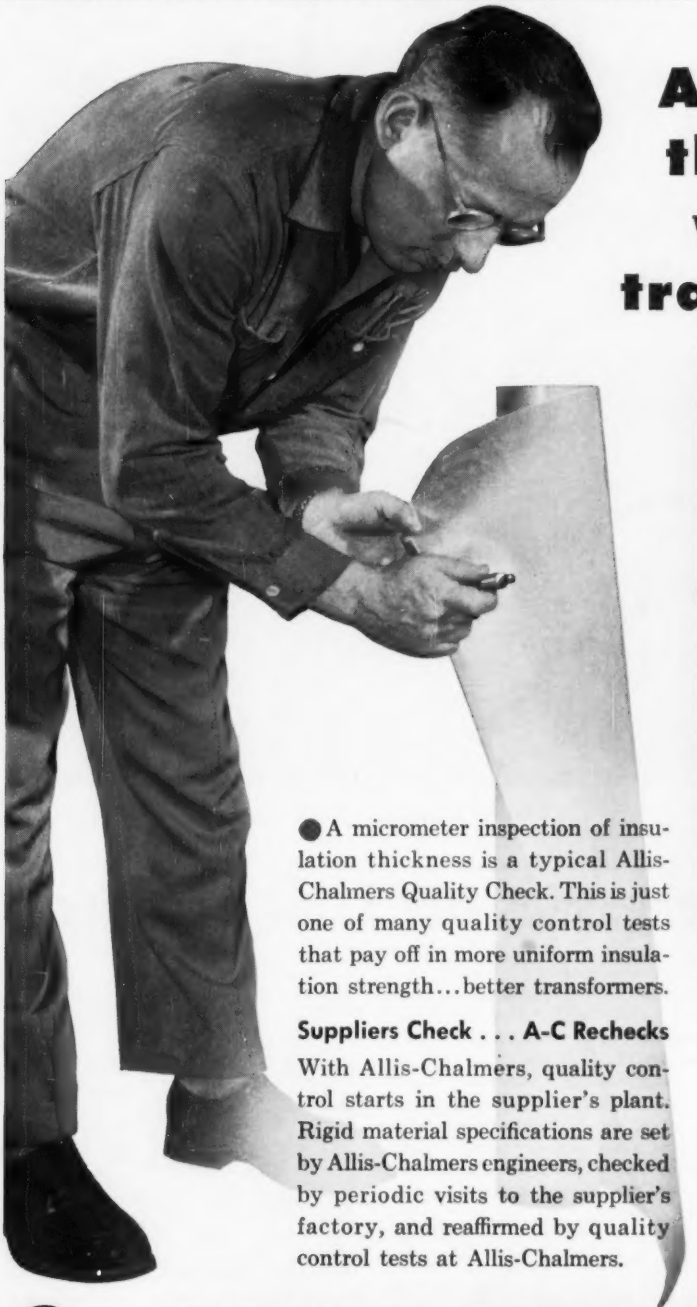
Basic to the job of keeping the plant producing is the 60-cell EME-25 Exide-Manchex Battery for control and emergency service. This battery provides power to trip and close switchgear, for emergency lighting, bearing lubricating pumps, and stand-by power to the substation control house.

The reason for the outstanding performance of Exide-Manchex Batteries in this service lies in their unique design and construction. In countless applications, these batteries deliver years longer service, and lower operating costs, than other types. No other battery can offer the same advantages. For complete information, write Exide Industrial Division, The Electric Storage Battery Co., Philadelphia 2, Pa.

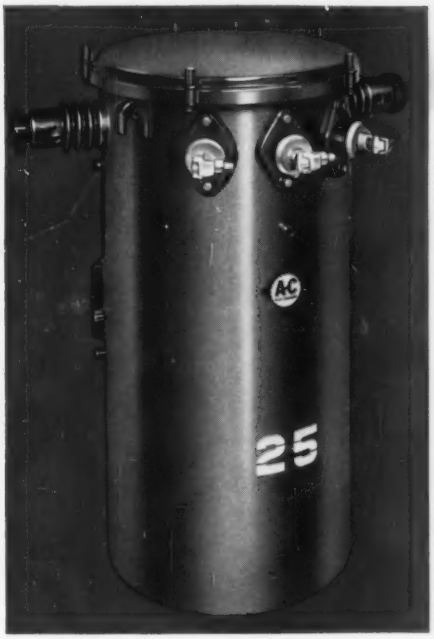
Exide®

Dependable power for control and emergencies. This 60-cell Exide-Manchex Battery plays a major role in keeping the Council Bluffs plant in operation. The dependability and long life for which these batteries are famous are especially vital in power company service. When you order batteries, be sure to specify Exide-Manchex.

Quality Control at Allis-Chalmers



A "Check" that pays off with longer transformer life



● A micrometer inspection of insulation thickness is a typical Allis-Chalmers Quality Check. This is just one of many quality control tests that pay off in more uniform insulation strength... better transformers.

Suppliers Check . . . A-C Rechecks

With Allis-Chalmers, quality control starts in the supplier's plant. Rigid material specifications are set by Allis-Chalmers engineers, checked by periodic visits to the supplier's factory, and reaffirmed by quality control tests at Allis-Chalmers.

For the Complete Story on quality control at Allis-Chalmers

. . . and what it means to you, call your nearby Allis-Chalmers office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin for new Bulletin 61B8355.

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